DOCUMENT RESUME

ED 332 845 RC 018 119

AUTHOR Currer, Joanne M.
TITLE Distance Learning Using Digital Fiber Optics: Applications, Technologies, and Benefits.
INSTITUTION State Univ. of New York, Oneonta. Coll. at Oneonta. Eastern Stream Center on Resources and Training.
REPORT NO ES-9-101
PUB DATE Feb 91
NOTE 117p.
PUB TYPE Reports - Descriptive (141) -- Information Analyses (070)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS *Advanced Courses; Audiovisual Communications; *Distance Education; Educational Technology; Elementary Secondary Education; Instructional Materials; *Interactive Video; *Networks; *Rural Schools; Telephone Communications Systems; Video Equipment
IDENTIFIERS *Fiber Optics; Mississippi; Oklahoma

ABSTRACT

Distance learning provides special or advanced classes in rural schools where declining population has led to decreased funding and fewer classes. With full-motion video using digital fiber, two or more sites are connected into a two-way, full-motion, video conference. The teacher can see and hear the students, and the students can see and hear the teacher and other students. A camera transmits the image of a visual aid. Facing economic decline, the Oklahoma Panhandle selected a fiber network that will eventually connect 13 rural schools and Panhandle State University. The network is used by elementary and secondary students, as well as adults in the community. Different from a satellite network, a fiber system allows for local control of the curricula. The Mississippi 2000 project uses a switched broadband network with digital fiber as its transmission medium: one fiber pair will leave each school, and a special switch will route the signal to all other classes over their fiber pair. Initially, the network connects four high schools scattered throughout the state, three institutions of higher education, and the Education TV station in Jackson (Mississippi). The report contains detailed information about the equipment, network set-up, and classroom arrangements for both projects. The appendix contains abbreviated information from the report in a presentation format, which can be used to make overhead transparencies. (KS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Joanne M. Currer

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Distance Learning Using Digital Fiber Optics

Applications, technologies, and benefits

Publication number: ES 9101
Date: February 1991

© 1991 Northern Telecom
All rights reserved.

IBM is a registered trademark of International Business Machines Corporation. Macintosh is a registered trademark of Apple Computer, Inc.

Acknowledgements

Many people contributed to this document. Education Systems wishes to acknowedge their assistance. We would like to give special thanks for the time spent by Dr. Philip Knight from the Panhandle Shar-Ed Video Network, and Claude Champagne, Dan Hunt, and Yodha Singh, all from Northern Telecom.

We also would like to acknowledge two sources from which we obtained general information about various distance learning methods and their costs: Linking for Learning, *published by the Office of Technology Assessment, Congress of the United States; and "Issues for Educators, Distance Learning in Texas Schools," a series of monographs written by Linda Lloyd of the Texas Association of School Boards (TASB).*

Contents

About this document	vii
A quick look at distance learning technologies	1
The Oklahoma Panhandle	7
Mississippi 2000	21
Appendix: Presentation Materials	37

About this document

Full-motion, interactive, instructional video. You may have wondered what it is. If you know what it is, you may have wondered how it compares with other methods of distance learning. Or you may have wondered how educators are successfully using it and whether it would be effective in your community. If you have any of these questions, you'll find this document helpful.

In the first section, we'll give a brief description of various distance learning technologies and show how they compare to each other.

The next two sections detail applications of distance learning using fiber optics — one in Oklahoma and one in Mississippi. We'll describe why these educators chose the systems they did, how the systems were implemented, and how they are being used.

An appendix contains outlines of chapters 1, 2, and 3 in a format appropriate for presentations. Feel free to copy and use them.

If you'd like to learn more about distance learning in general or about these specific applications, please give us a call at 1-800-NORTHERN. We'll be glad to talk with you about your distance learning or other telecommunications needs, and will help you find a solution that's best for your schools and your students.

Chapter 1: A quick look at distance learning technologies

The concept of distance learning isn't new. Before television, students took correspondence courses and listened to instructional radio. Once television entered our homes in great numbers in the '50s, video instruction entered our homes as well, from educational television stations that started to spring up across the country. VCRs changed the concept of distance learning, too, giving learners the opportunity to take video-based classes at their convenience.

Whatever the method, distance learning responded to a need — isolated, homebound students who were unable to attend class. But there was one major drawback: the communication was from teacher to student only. If students wanted to correspond with an instructor, they wrote a letter and waited for a response.

Today, various transmission media bring a variety of classes into schools and homes. With few exceptions, however, communication is still one-way — from teacher to student. And students almost *never* see each other.

And, today the issue of isolation is as complicated as our ever-changing society.

Today's isolation problems and how distance learning is helping

Although it sometimes is easy to think of rural America as idyllic and complete, some rural students are among our most disadvantaged and isolated. Many rural areas are experiencing education crises that rival those of the inner cities. Declining rural population decreases funding, which leads to fewer classes. Students may not be able to take the special or advanced classes they need. And, in some cases, schools are forced to close. Distance learning is helping to make more classes available to students. And with the availability of required classes, some communities are able to keep their schools open.

Even in crowded urban schools, some students may experience isolation. While educators spend resources on the majority of students, the needs of exceptional students may be ignored. And, although equity is a hot national issue, the reality is that many inner city schools still lack the resources of schools in wealthier districts. Distance learning is helping to solve these problems by providing college prep and advanced classes from other high schools, community colleges, or universities, while freeing teachers to spend time with students who need more personal attention.

Even in wealthier districts, interest in some special classes may not be high enough to support a dedicated teacher at each school. Or qualified teachers may not be available. Distance learning is one way to share the resource of a specialized teacher and offer students the opportunity to attend an otherwise unavailable class.

And, of course, we still have homebound students who are unable to physically attend a school, and adults who are either unable to attend class or who prefer the convenience of home learning. Distance learning continues to offer learning opportunities to these students as well.

How technology has affected distance learning

Using the term "distance learning" loosely, we probably can think of books as one of the earliest methods of distance learning. After all, history has taught us that Abe Lincoln learned by borrowing books and reading them at home. But he was an exception. Few students have the incentive to teach themselves. That's why interaction is so important.

Video As technology has improved communications in general, these same improvements have increased teacher/student interaction in distance learning. We've already talked about books, where there is zero interaction. Radio provides voice. Satellite, microwave, and cable provide video as well as voice, but interaction still is non-existent, or limited at best.

Telephone Although teleconferences don't provide video, they do provide interaction. Courses that depend on discussion rather than visuals, literature or philosophy perhaps, lend themselves rather well to this relatively inexpensive means of distance learning, especially if students are motivated learners.

Video and telephone By combining satellite-, microwave-, or cable-based distance learning with the telephone, a small measure of interaction becomes part of the class, but it's generally accomplished by students calling class facilitators with questions. Remember, most satellite and cable transmissions are broadcast to many, many students, far too great a number to be involved in an interactive teleconference.

Two-way, full-motion video The technology that most closely duplicates the teacher/classroom environment is two-way, full-motion video. All students see the teacher. The teacher sees all students. Students see each other. And, of almost equal importance, everyone can hear everyone. Students can ask questions and receive answers just as in a real classroom — no phone calls to make or questions to mail. It's as if the teacher is right there.

Adults attending a sociology course may learn quite well via voice teleconferencing. However, what would an advanced art class be like if teachers and students couldn't see and converse with each other? Or what about a biology class? It's hard to imagine attending a biology class without asking questions about what the teacher is demonstrating with a live subject or detailed illustration or photo. Two-way, full-motion, interactive, video is the solution.

What about compensated-motion video? Compensated-motion video provides video and voice communications, it's true. But the movement in the picture is disjointed and sometimes jerky. Although compensated-motion video might be perfectly acceptable in some learning situations, if you want to duplicate the traditional classroom setting as closely as possible, you need full-motion video.

Why use fiber optics?

Fiber-based technology is not inexpensive. Other distance learning technologies are less expensive and may serve your purposes quite well. However, if you plan to use distance learning for a variety of classes at more than a few schools, and if you want the technology that most closely duplicates a normal classroom environment, fiber is the technology to choose. And if you want to use the network to it's fullest capacity and get the most for your money, digital fiber is what you want.

Why digital fiber instead of analog? One of the advantages of digital fiber is the high picture quality. Even over long distances, digital fiber networks produce clear, crisp video images.

Another advantage of digital fiber is that the piece of equipment that transmits the signal over the fiber also acts as a multiplexor. This means that the digital video signal can be combined with other digital signals — video, data, FAX, or voice — and transmitted over the same fiber. Analog fiber does not offer this capability. With analog fiber, you can transmit analog signals only. That's very limiting.

As you read chapters 2 and 3, you'll learn more about fiber-based distance learning and why the project teams in the Oklahoma Panhandle and Mississippi chose it.

Summary of telecommunications-based distance learning methods

The table on this and the next page gives very general information about several of the most common distance learning methods. The information in the table is not meant to be exhaustive, but gives approximate characteristics and costs as guidelines *only*.

	Voice teleconferencing	Audio-graphics teleconferencing	One-way satellite/cable networks (public)
Method	Two or more sites connected into a teleconference. Everyone hears everyone else. Paperwork mailed or faxed.	Two or more sites connected into a teleconference. Everyone hears everyone else. Graphic information transmitted to each site's PC via telephone lines. Annotations to graphics transmitted with graphics.	High quality video of instructor and class aids transmitted to subscribers. Great variety of courses and enrichment programs available. Easy for schools to use.
Equip.	Telephones, conference bridge.	Telephones, PCs, scanners, printers, video cameras, data lines.	TV monitors, satellite/microwave/ cable hookup, telephones.
Costs	Bridge. Purchase at $1000-$2000/port or rent on a per port per minute basis when needed. Plus line charges.	PC and peripherals (< $5000) plus s/w from $3500-$5000. Line charges from $15-$30/line/hour.	$1,000-10,000 for satellite downlinks. Subscription fees from $2,000-10,000; may include peripherals and maintenance. Special programs may cost extra. Cable installation from $18,000-$25,000/mile; <$10,000 for receiving site equipment. Cable maintenance <2-5% of system cost.
Advantages	Real-time voice communications. Equipment and operations are relatively inexpensive, easy to use.	Real-time voice/data communications. Most sites already have PCs, scanners, printers and video cameras, so s/w may be only extra cost. Graphic images sent easily and quickly.	High quality video of instructor and class aids. Great variety of courses and enrichment programs. Easy for schools to use. Satellites not restricted by geography.
Disadvantages	No video. Mailing or faxing all visual aids inconvenient.	No live video of instructor. Not all phone systems support this equipment.	May be unable to interact with instructor during class; if students can interact, it's by phone, usually WATS lines. Subject to curricula and schedules of course providers. 2-way video is not an option; teachers cannot see students; students cannot see other students. Large number of students per class. No local control.

	Microwave networks (private)	Compensated-motion (compressed) video	Full-motion video using digital fiber
Method	Privately owned microwave networks. Courses and programs developed for specific students.	Two or more sites connected into a video-teleconference. The teacher can see and hear students; students can see and hear the teacher and other students. Second camera transmits image of visual aid.	Two or more sites connected into a two-way, full-motion, video conference. The teacher can see and hear students; students can see and hear the teacher and other students. Second camera transmits image of visual aid.
Equip.	Microwave transmit/receive system, monitors, phones.	Video codecs for transmission/ reception, monitors for classrooms, high speed telephone lines.	Video codecs for transmission/ reception, monitors for classrooms, fiber plant.
Costs	Transmit site cost of $60,000 plus tower (up to $50,000); receive sites <$10,000 plus tower ($3000-$50,000). Lease/purchase agreements may be an option. Insurance, maintenance, repairs between 3-5% of system cost/year. Costs can be reduced by limiting number of transmit sites.	$60,000/site plus line costs. Lease/purchase agreements may be an option. Costs are expected to drop rapidly as technology improves. Line costs start at about $30/line/hour; usually 2 lines required.	$10,000-$50,000 for classroom coders/decoders, plus monitor and microphone costs. Lease/purchase agreements may be an option. Costs are expected to drop in the future. Fiber installation plus usage. Line costs about $30-70/mile/month.
Advantages	High quality video of instructor and class aids. Curricula controlled locally. Generally low teacher/ student ratio.	Real-time voice and graphic communications. Teachers and students see and hear each other. High quality voice communi-cations. Quite easy to use. Local control.	High quality video of instructor and class aids. Teacher and students see and hear each other; students hear and see other students. Easy interaction. Can transmit voice/data/graphics. Local control.
Disadvantages	Geographic limitations. May need extra personnel to manage system. Expansion is expensive.	Video is not full motion; may not be appropriate for courses requiring action or high levels of observation.	Cost for network facilities may be prohibitive. Fiber may not be available; if available, may be expensive. Depending on configuration, expansion may be quite expensive.

Chapter 2: The Oklahoma Panhandle

The mid- to late-1980s brought about a drastic decline in the economy of the Oklahoma Panhandle, a rural area that never has been considered wealthy. As the economy declined, so did the resources available for education. But then the story changed direction. Through the cooperation of the school districts, private industry, and government, a fiber optic network is helping to revitalize education and the communities.

Problem

One of the challenges facing educators in the Oklahoma Panhandle was its rural environment. With a small enrollment spread over a large area, it was impossible to support enough teachers to teach all classes at all schools, even with a healthy economy. Limited education is not unusual in rural America.

The economic decline compounded the problem of rural isolation.

- The failing economy led to reduced funding for education.
- Reduced funding led to loss of teachers and classes.
- Loss of teachers and classes led to restricted curricula.
- Restricted curricula was threatening some schools with loss of accreditation and possible closure.

Obviously, this chain of events was hurting students. They missed classes they wanted and needed. For some students, missing these classes meant failure to learn useful skills or failure to gain entrance to chosen colleges or universities. And students weren't the only victims.

Declining education further threatened the general economy of the area. Teachers without classes and school administrators without schools would become unemployed citizens. Vendors — including local companies and public utilities — would lose the schools as customers. The downward economic spiral would continue.

Oklahoma education, business, and state leaders weren't satisfied to sit back and let events unfold. They decided to solve the problem of limited funding and resources, and help the schools, communities, and the state of Oklahoma as well.

Solution

Oklahoma Panhandle school superintendents and school board members knew distance learning was the solution to resource sharing in the Panhandle, but they weren't sure exactly what technology would serve them best. So they conducted research, even visiting networks in Wisconsin and Minnesota. They also hired consultants. With the cooperation of the State Director of Rural Education, Panhandle Telephone Cooperative, Inc. (PTCI), and its subsidiary, Panhandle Telecommunications Systems, Inc., the educators selected a digital, fiber-based, two-way, full-motion interactive video system, called the Panhandle Shar-Ed Video Network.

Why full-motion, interactive video?

Full-motion video was an easy choice for the cooperative members. They wanted to duplicate the live classroom as closely as possible, providing two-way audio and video so teachers could see and hear students and so students could see and hear the teacher and other students.

Why fiber?

The cooperative members chose fiber because of its excellent transmission capabilities, necessary for full-motion video. Fiber also meant that educators would have local control. They would develop their own curricula and transmit their own classes. They didn't want to rely on the offerings of satellite networks, which would have provided full-motion video but no local control.

Why digital fiber?

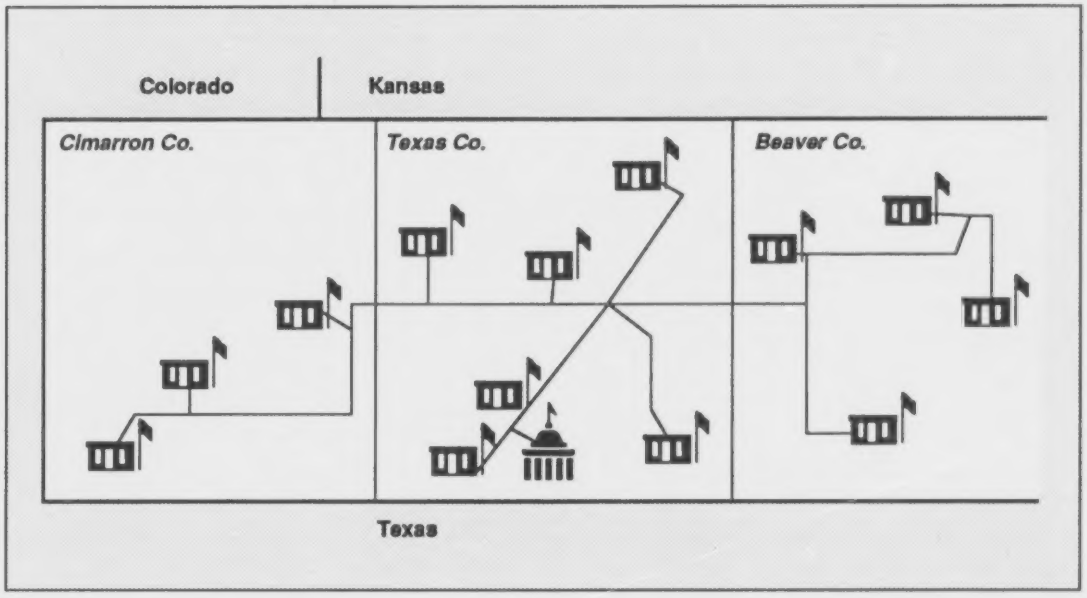
Cooperative members chose digital fiber because of its high picture quality, because of its versatility, and because the school districts could use common facilities that were being installed throughout the area. Sharing common facilities was an important factor in the decision to proceed with this distance learning network. If the schools had required a standalone fiber network, the cost would have been prohibitive, and the project never would have proceeded. The importance of this cooperative effort between business and education sectors cannot be minimized.

What the network provides

When the fiber network is complete, 13 rural Oklahoma schools and Panhandle State University will be connected together in a network that provides a variety of connection possibilities.

Schools will share resources, providing improved classroom opportunities to students. The communities also will benefit, using the video facilities for adult education and enrichment programs during the evening.

Panhandle Shar-Ed Video Network



Action

The school districts and Panhandle Telecommunications Systems, Inc, a subsidiary of PTCI, established the Panhandle Shar-Ed Video Network Cooperative to oversee the project. The cooperative, in turn, employed Associated Communications & Research Services, Inc. to design and implement the system.

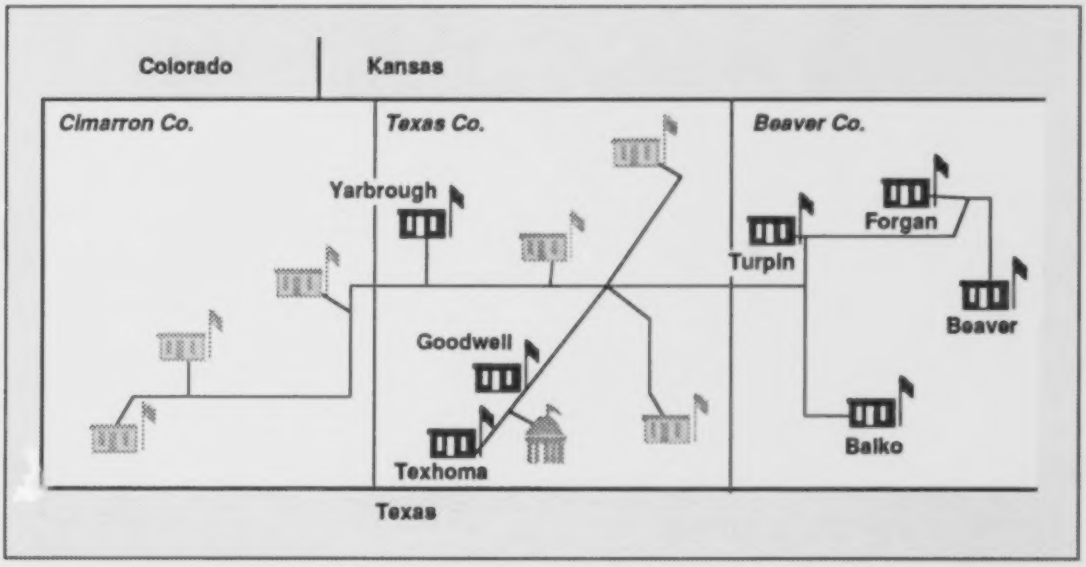
The current Panhandle Shar-Ed Video Network

Four schools in Beaver County were brought online for the start of the 1989–90 school year. Balko Schools transmitted Accounting II, Turpin transmitted Art History, Forgan transmitted Spanish, and Beaver transmitted Advanced Placement English. Teachers could see and hear the other classes. Students in remote classes could see and hear the remote teacher as well as other remote students.

During the 1990-91 school year, seven classes were being taught at those original four schools: Advanced English (2 classes), Accounting II, Spanish I & II, and Art I & II.

Also during the 1990-91 school year, three additional schools in Texas County were added to the network. Texhoma is transmitting Spanish I, Goodwell is transmitting Advanced Math as well as speech therapy sessions, and Yarbrough is transmitting Advanced Placement English and college-level General Psychology. Currently, the three new schools are transmitting and receiving classes only among themselves; likewise with the original four schools.

Network at start of 1990-91 school year



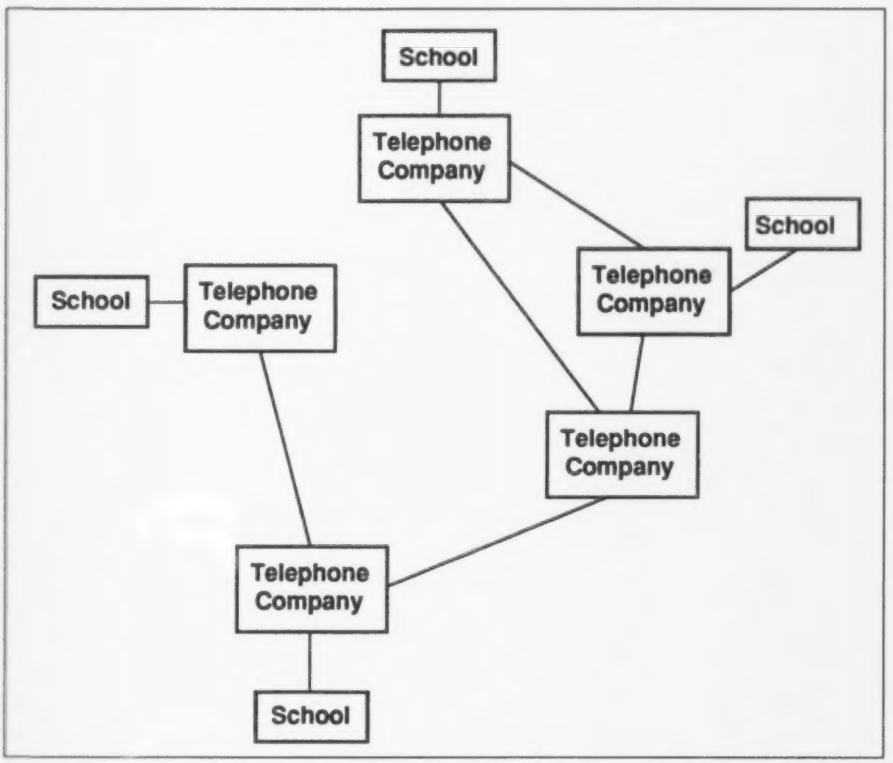
Starting in January 1991, a Northwestern Oklahoma State University graduate class in education administration is being taught over the network. Although the university is located in Alva, the class is transmitted from Yarbrough to other schools in Texas County as well as Beaver County. It is the first class to span county lines.

Elementary students and adults use the network as well. Spanish enrichment programs are offered to a group of 5th and 7th graders. Other community classes and enrichment programs currently include aerobics, travel, image improvement, people's law, fruit trees, and landscaping.

A closer view of the network

The network consists of video classrooms connected through their schools to telephone company central offices, which in turn are connected to other central offices, other schools, and other video classrooms.

High level connectivity between schools and telephone companies



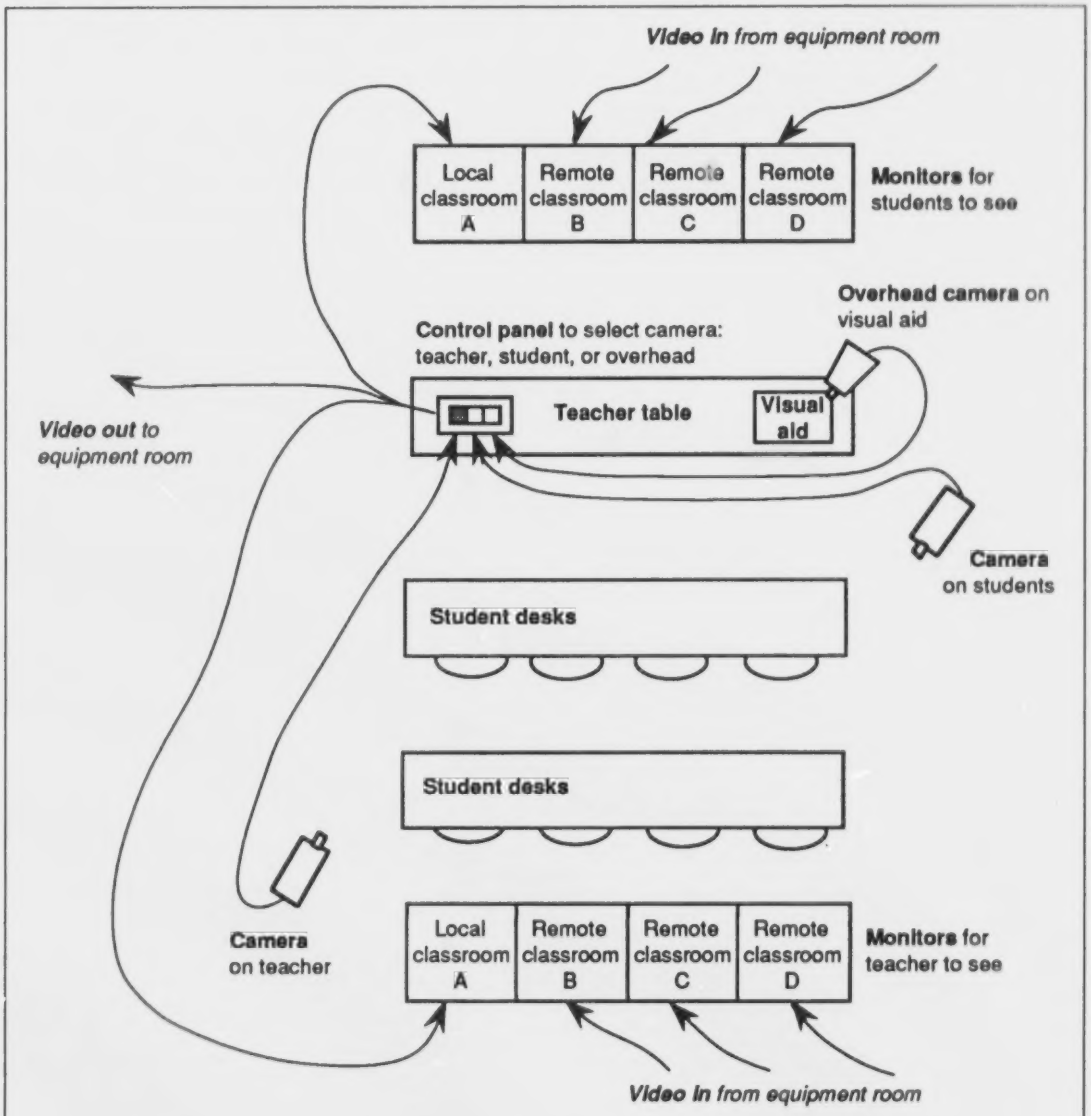
The classroom Each video classroom is set up identically. The basic configuration is as follows:

- Three video cameras. One focuses on the students, for transmission to remote sites. If there is a teacher present, the second focuses on the teacher, and the third is an overhead camera that focuses on visual aids on the teacher's table.
- A video control panel. The teacher controls whether the image from the teacher's camera, the overhead camera, or the student camera is transmitted. The teacher also can choose to transmit video from a VCR, laser disk unit, or computer. And he or she also can choose to tape the class for viewing by students who missed the class or need to review it.
- Eight video monitors. Four monitors hang from the ceiling in the middle of the room. These monitors face the teacher. Four monitors are mounted in the front of the raised teachers table. These are for the students use. Both banks of monitors display the same images. One monitor shows the teacher or the image from the overhead camera. The other three show the students at the three remote sites. The difference between the teaching classroom and the remote classrooms is that the students in the teaching classroom see the teacher on video *and* live.
- Microphones and speakers, placed strategically throughout the room.

Other notes about the classroom configuration:

- All video cabling within the classroom and school is coaxial.
- The video signal from the teacher camera or overhead camera that goes through the control panel is split. Two cables go directly from the control panel to monitors that the students and teacher can see. Another cable goes to the equipment room for transmission outside the school.
- Voice signals are transmitted and received with the video signal. A teleconferencing system *is not* required for this type of network.

Typical Panhandle Network classroom equipment and setup



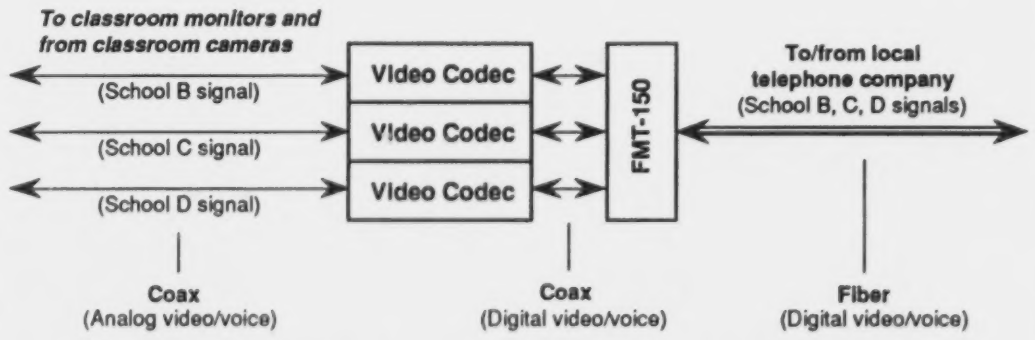
Notes: For clarity purposes, the drawing shows the student monitors at the front of the classroom and the teacher monitors at the back of the classroom. In most classrooms, student monitors are mounted in a raised teachers table, and teacher monitors hang from the ceiling over the student tables.
Microphones and speakers are not shown, but are located strategically throughout the room.

The school / telephone company connection Once the video and voice signaling reaches the school's equipment room, it's transmitted onto the fiber network and to remote sites.

School to telephone company:

- As the analog video and voice signals arrive on coax cable from the classroom, a video codec (coder/decoder unit) samples and digitizes the signals. Then, the codec passes the signals over coax cable at 45 megabits/second (DS-3) to a fiber multiplexor terminal. In the current network configuration in Beaver county, three codecs are required at each school — one for each remote classroom. (The codecs and multiplexor generally reside in the same cabinet or an adjacent cabinet.)
- A fiber multiplexor terminal (FMT-150) combines the digitized video signals and transmits them over the fiber that connects the school with the local telephone company central office. These transmission speeds are 155 megabits/second (three DS-3's).

Typical equipment room at Panhandle Network school



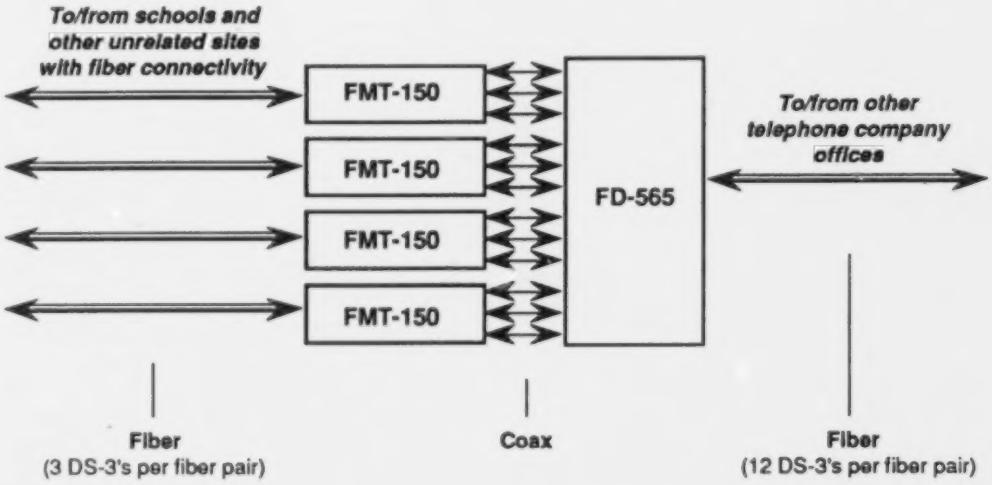
For transmission, codec converts standard analog video signals to digital signals. FMT-150 multiplexes and transmits up to three (3) DS-3 signals over one fiber pair. For reception, process is reversed.

One codec required for each DS-3; current configuration requires one DS-3 for each of the three other classrooms.

Telephone company to telephone company:

- When the signals reach the telephone company, similar fiber multiplexors (FMT-150's) retransmit the signal to a larger fiber multiplexor (FD-565). The FD-565 combines the digital signals with digital signals from other sources and transmits them to their various destinations at speeds of 565 megabits/second (12 DS-3's).

Typical telephone company central office on the Panhandle Network



FMT-150's de-multiplex the DS-3 digital signals (3 per FMT-150) from the school and other customers. FD-565 multiplexes the signals and transmits the signals over fiber to FD-565's at other telephone companies.

All signals remain digital, which ensures the high quality of the information, regardless of distance or number of times they are multiplexed.

Each FD-565 can multiplex 12 DS-3's (from 4 FMT-150's).

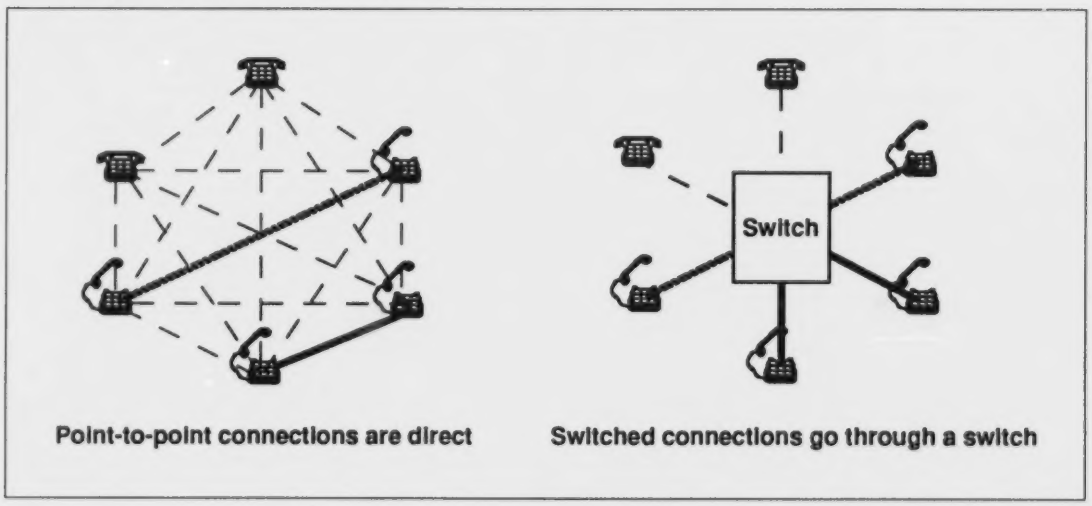
Telephone company to school:

- When the digital signals reach the receiving telephone company, the process in the above step is reversed. The signals are split, re-multiplexed (or combined), and retransmitted toward their destinations.
- When the digital signals reach the destination school, the fiber multiplexor in the equipment room splits the fiber signals and passes them over coax cable to the codecs.
- Still in the equipment room, the video codecs reverse the sampling process and convert the digital signals to analog video and voice. Then they transmit the analog signals over coax cable to the classroom and the appropriate monitors and speakers.

Point-to-point vs. switched networking While this type of point-to-point configuration provides cost-effective, two-way video and voice communications for four schools or less, adding another school is *not* simple, as you must add fiber connectivity and additional coders/decoders, cable, and monitors in *all* schools — the new school as well as those already on the network. Plus, it limits the network to one class being taught at any one time.

If this concept seems confusing, think about your home telephone. With the earliest telephone systems, each telephone was directly wired to other telephones. It's not difficult to imagine the tangled wire. The invention of the telephone switch changed all that, by making the connections within a telephone company. When you want to talk with New York, the switch sends your call off on that line. When you want to talk with California, it sends your call off on another line.

Point-to-point vs. switched networks



The concept of a switched video network is similar. Rather than have a strand of fiber that goes directly from one location to another (yes, it does go through telephone companies, but it's still a one-to-one connection), a special type of switch can switch the video signal much like a normal telephone company central office switch. Although the switch is not inexpensive, neither is the process of adding fiber and all sorts of extra equipment to the network for each additional school. And the versatility added by the switch makes the network more usable. Rather than holding only one class at a time, switching allows simultaneous classes to various configurations of schools.

Expanding to a switched network To expand the network, Panhandle Shar-Ed Video Network Cooperative plans to install a digital crossconnect switch within the network. What does this mean to the network?

- New video classrooms will be equipped as the original four classrooms are — four monitors for the teacher and four for the students, plus video transmitting and receiving equipment.
- When new schools are added to the network, no new equipment will be required at schools already on the network.
- Any four schools will be able transmit to/receive from each other. (Schools will be able to transmit to more than four schools, but they will not be able to receive video and voice from more than three other schools.) Other groups of up to four schools will be able to communicate at the same time.
- Schedules can be programmed ahead of time so that, for example, every Tuesday morning at 8:30, Turpin might transmit Art II to Forgan, Beaver, and Goodwell. At the same time, Balko might transmit Accounting II to Texhoma. At 10:30, the switch would change connections automatically, as programmed, so Forgan can transmit Spanish II to Beaver, Texhoma, and Goodwell.
- Connections also can be made on an ad hoc basis.

What's next in the Oklahoma Panhandle?

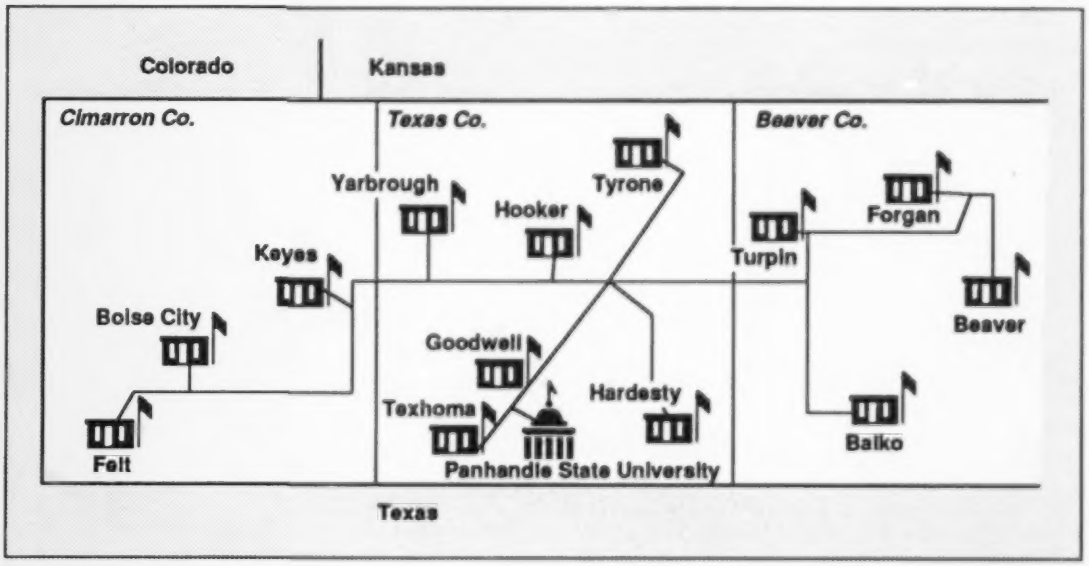
Panhandle State University (PSU) will be added to the network by July 1991. Starting with the 1991-92 school year, PSU will transmit undergraduate classes throughout the network. Initially, Panhandle State's video classroom will be equipped similarly to those of the public schools. However, they plan to expand their facilities so they can transmit classes to 12 schools concurrently, with each school having full, two-way, video and voice communications.

Another exciting new program starts early 1991 in cooperation with the Regional 5 Rural Technological Assistance Center in Denver, Colorado. Goodwell will be transmitting a 3rd grade math class to Chapter I students at Texhoma, Yarbrough, and Turpin schools. This program is the first of its kind to use federal Chapter I funds to test the effectiveness of distance learning for disadvantaged elementary school students.

Six additional schools — Tyrone, Hooker, and Hardesty in Texas County, and Keyes, Felt, and Boise City in Cimarron County — will be added to the network for the 1991-92 school year. When these schools are added, all schools will have transmit/receive capabilities with each other.

And the plans don't end there. The cooperative intends to extend the program to include additional community education, elementary and in-service training, and eventually, vocational-technical schools and other colleges.

Panhandle Shar-Ed Video Network at completion



Results

The network is a resounding success for all involved. Students are taking classes that previously were unavailable. They are meeting students from other schools and learning about new technology in the process. Educators are improving the quality of education for their students and providing a working model for other communities with similar problems. The businesses and communities have benefited, too. They've kept some good customers and improved their communities at the same time.

Read what some of those involved in the project have said. Listen carefully to the words as these people speak about what this project has meant to them.

- Dr. Philip Knight, Superintendent of Schools: "One of the essential things for school districts is to have local control of curricula. Satellite networks didn't offer a full complement of classes. Now we control our curricula and provide classes that meet *our* specific needs."
- Sheryl Melton, Advanced Placement Teacher: "Our county has grown closer. ... Many times we think of people in rural areas as being isolated. And this has given our students an opportunity to become involved and to see the future. And we've got the best of two worlds. These kids are from a nice wonderful rural foundation at home, but yet we come to school and see the high tech and we see the wonderful things that they can do. And this is tomorrow. This is the future, and the kids are getting to be actively involved with that ... "
- Gary Kennedy, Manager, Panhandle Telephone Cooperative Inc.: "We looked upon this as real economic development in our community. ... With the possibility of schools being closed, we realized that we would also lose a decent customer. ... One way of being able to cut expenses (is) with the use of a video network where one teacher in one school will be able to teach their class plus three other schools. I think that this is going to pull the four communities closer together, because there will be activities that will involve the students plus the adults.
- Doug Rundle, Superintendent of Schools: The network has "given us a broad base to develop a school-wide curriculum. It's given us an opportunity to share county-wide resources. And it's just given our students an opportunity that our geographical location has possibly limited them to."
- Dick Robinson, Art Teacher: "Once you communicate with a student at a remote school, distance disappears, cameras melt away, and it's a classroom again."
- Roger Hilton, School Principal: "I think for the most part that only our limitations of the mind will limit what we do with this medium."

They've exceeded their goals

When the Oklahoma Panhandle residents started this project, they set six goals:

- √ Develop a state of the art video network linking the school systems of the Oklahoma Panhandle.
- √ Ensure capability of simultaneous transmission of curriculum from any one school to classrooms located at any of the schools.
- √ Ensure capability for any of the schools to be the point of origin with ability to control transmission from that location.
- √ Ensure the capability to allow more than one curriculum to be taught at the same time.
- √ Ensure that transmission would be two-way video/audio.
- √ Ensure ample growth potential, and design the network to allow the interconnection of additional county video systems with the long range potential of including the entire Panhandle.

Think about the goals. Think about the network and the classes being taught over it. Think about the effect on the students and the community. When the network is complete, the people in the Oklahoma Panhandle will have reached their goals … and stretched far beyond.

Chapter 3: Mississippi 2000

Mississippi 2000. If you think a project by that name has something to do with the state of Mississippi and the year 2000, you're right. Mississippi 2000 is a public/private effort that will help propel education in Mississippi into the 21st century. It's fiber-based distance learning for children and adults. It's enrichment and in-service programs for teachers. It's data networking. It's cooperation between the public and private sectors to help meet one of this country's most pressing challenges — equitable education for all.

Problem

Mississippi is a state rich in history and spirit, but with limited economic resources. And as a state with small, isolated schools in its largely rural environment, educators find it difficult to attract and retain qualified teachers.

Although Mississippi does have disadvantaged students, it also has a large group of students who qualify for advanced placement classes but who never have the chance to take them. In fact, of the 50 states, Mississippi ranks 49th in the number of students taking advanced placement classes. That translates into fewer educational opportunities for high school graduates. And that leads to fewer economic opportunities for Mississippi and its citizens. This situation in no way reflects on the quality of Mississippi students. The reality of the situation is that qualified teachers are not always available where high-potential students are.

As for those teachers the state does hire, the isolated environment makes it difficult for them to communicate with their peers, receive in-service training, and participate in enrichment programs.

Governor Ray Mabus found the situation unacceptable, as did business and education leaders in Mississippi, who accepted the challenge to improve the state's economic and educational climate. They understood that economic development is essential to the future of the state, and that the key to this development is education. They understood the need for a way to leverage and share resources to expand educational opportunities. And they understood that they would have to work together to improve opportunities for all Mississippi residents.

Solution

Governor Mabus established the BEST program, a statewide plan for educational improvement. Part of the plan is a learning readiness program for disadvantaged preschool students. Another goal is to provide at least one hour of technology-based education to each student every day. Mississippi 2000 is one strategy for achieving this goal.

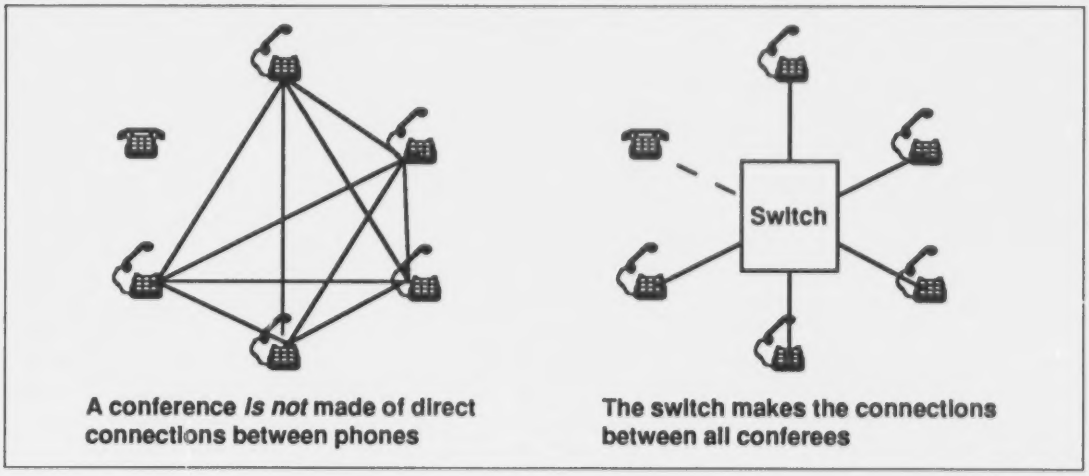
The mission of the Mississippi 2000 project team is to design, develop, and implement a multi-media distance learning infrastructure based on the digital and fiber optics technologies available in Mississippi. The State of Mississippi, in cooperation with South Central Bell Telephone, Northern Telecom Inc., International Business Machines Corporation (IBM), ADC Telecommunications, Inc., and Apple Computer, Inc., developed plans for a unique, switched, multi-media, distance learning system. The system will expand educational opportunities statewide.

The network will be "switched"

The Mississippi 2000 distance learning project will be the first in the country to use a switched broadband network with digital fiber as its transmission medium. Yes, other distance learning networks provide two-way, full-motion video for teachers and students. But those networks are point-to-point, which means there is a one-to-one relationship between the cabling and the classrooms — if you're transmitting to three schools, you need three connections. It's the switching architecture of the Mississippi 2000 network that makes it so unique.

The switched solution works much like a telephone conference call, during which you use just one telephone line to connect you with the telephone company central office. A special switch (conference bridge) connects you to all of the other telephones.

A telephone conference

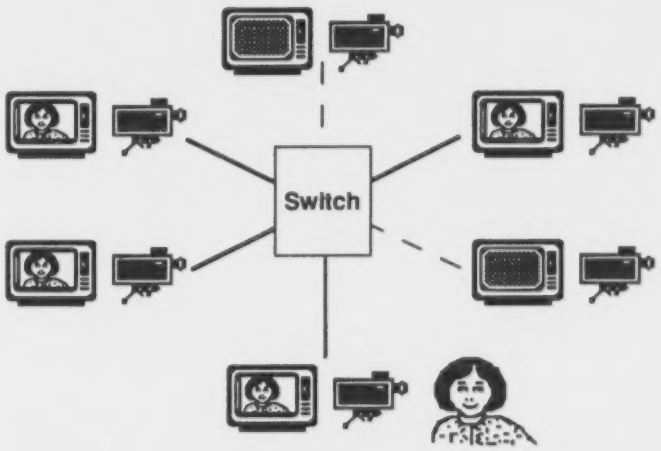


A conference *is not* made of direct connections between phones

The switch makes the connections between all conferees

The Mississippi 2000 network works in a similar fashion. One fiber pair will leave each school. A special switch, an MCS 3800 broadband switch, provided by ADC Telecommunications, Inc., will route the signal to all other classes over their fiber pair.

A switched video network



The switch makes the connection between all course participants

A switched network is cost effective While a switched network *initially* may cost more than a point-to-point network, over the years it is more economical and much more versatile. When adding new schools, equipment needs to be added only at the new school; in a point-to-point network, additional fiber and optical electronic equipment would be required at *each* site. A switched network also provides the capability to teach multiple, simultaneous classes, a real plus in the decision to spend the extra money on a switched network in return for increased versatility.

A switched network is versatile The entire network can participate in any one class. At the other extreme, the network can accommodate multiple transmissions for smaller classes being held at the same time.

The switch can be programmed ahead of time so that, for example, every Tuesday morning at 8:30, School A can transmit a class to Schools B and C. At the same time, School D can transmit a different class to Schools E, F, and G. At 10:30, as programmed, the switch will change connections automatically so School D can transmit a class to Schools A, F, and G . Connections also can be made on an ad hoc basis.

What were some other network requirements?

Besides specifying the flexibility of a switched system, the project team had other requirements:

- The network would use off-the-shelf hardware and software. No hardware would be custom-designed for Mississippi 2000.
- The equipment would meet current telecommunications and computing standards, and the technology would be state-of-the art.
- The network would be open. Expansion would be simple and unlimited.
- The network would be easy to use. Educators would not have to be technology wizards to use the equipment.

Digital fiber was essential The project team made an early decision to use digital fiber. It is digital fiber that provides the means to transmit multimedia information over the network. It is digital fiber that provides the versatility of the switched network. And it is digital fiber that provides the high transmission speeds and high video and audio quality the project team demanded for the Mississippi 2000 network.

Action

The Mississippi 2000 project team comprises superintendents, principals, and teachers from the school districts involved in the project, curriculum development specialists from the Mississippi Department of Education, university researchers, and Mississippi Educational TV and business representatives. The team met numerous times to finalize the plans and responsibilities for the network. Besides supplying planning and implementation assistance, team members made numerous other contributions.

- South Central Bell supplied the fiber network and associated network products and services, including installation of fiber to the schools and universities. This deployment is part of a planned $5 billion investment in Mississippi's telecommunications infrastructure over the next five years. (At the end of 1989, over 26,000 miles of fiber optic cable were in place. By the end of 1994, that figure will more than double to over 61,000 miles.)
- Northern Telecom Inc. supplied the video terminal equipment, including video codecs (coder/decoders) and fiber terminals at the schools, and integration software for control of the switched broadband network.
- IBM provided personal computers connected into local area networks (LANs) at each school. These LANs are connected on a single wide area network (WAN).
- ADC Telecommunications, Inc. supplied the broadband switch that gives the network its versatility.
- Apple Computer, Inc. provided the Macintosh workstations that act as classroom video controllers in the classrooms.
- The Mississippi Department of Education (DOE) supplied the classroom monitors and cameras. The DOE also coordinates curriculum development and monitors the project.
- The Mississippi Authority for Educational TV served as liaison between the private sector, the Mississippi DOE, the Mississippi Institute for Higher Learning, and the Governor's office. This group also has responsibility for monitoring the project's effects on state policies that may need to be changed or waived.

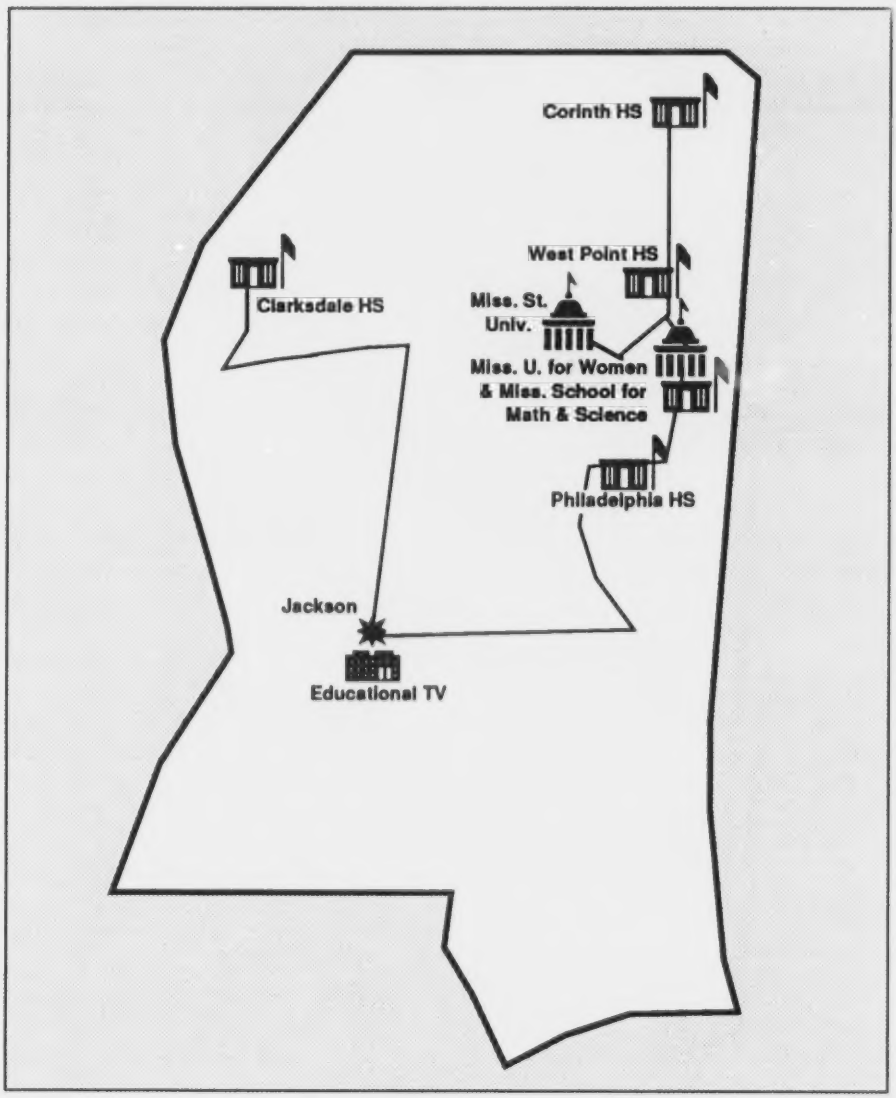
The first phase

Initially, the network connects four high schools scattered throughout the state (Clarksdale, Corinth, Philadelphia, and West Point), Mississippi State University in Starkville, Mississippi University for Women and The Mississippi School for Math and Science in Columbus, and the Educational TV station in Jackson, the state capital. Some schools will participate in an administrative data networking application trial.

January through June 1991, German, Probability and Statistics, Creative Writing, Oral Communications, and Computer Applications are being taught over the network. Teams of four teachers are working together to develop curricula jointly and share in teaching responsibilities.

Also during this time, curricula will be fine tuned. Teaching methods will be refined as teachers gain familiarity with the medium and experiment with new techniques.

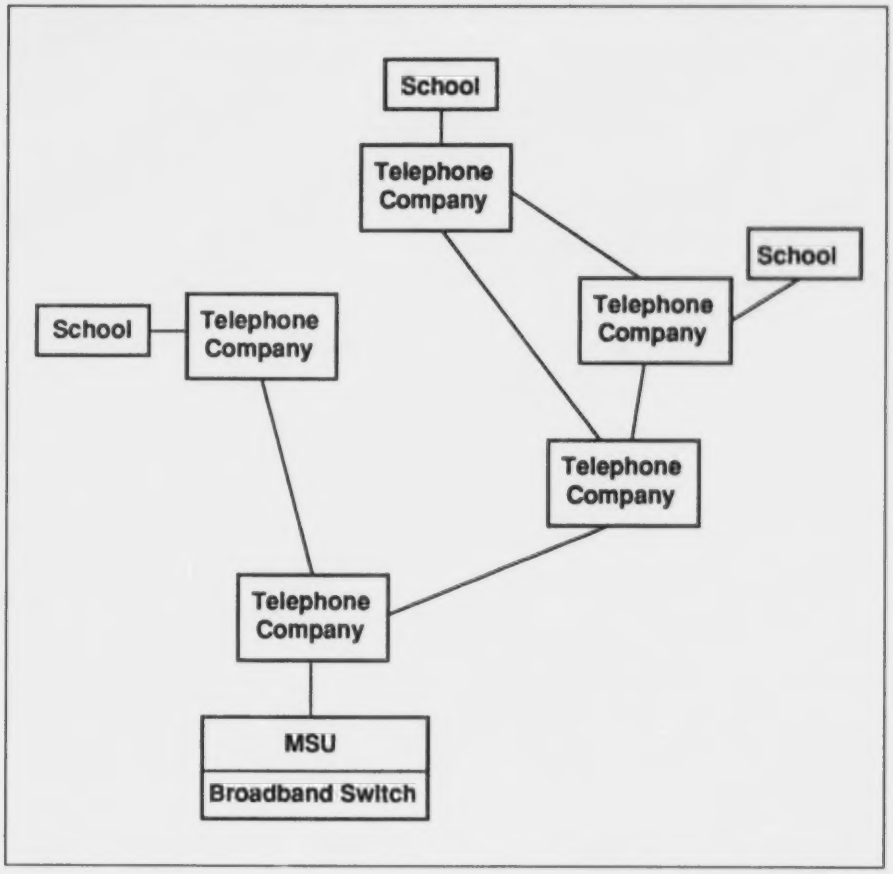
The first phase of Mississippi 2000



A closer view of the network

The Mississippi 2000 network consists of schools with video classrooms connected to telephone company central offices, which in turn are connected to other central offices and other schools. The broadband switch resides at Mississippi State University. *All* classes, regardless of origin, are routed through MSU.

High level connectivity between schools and telephone companies



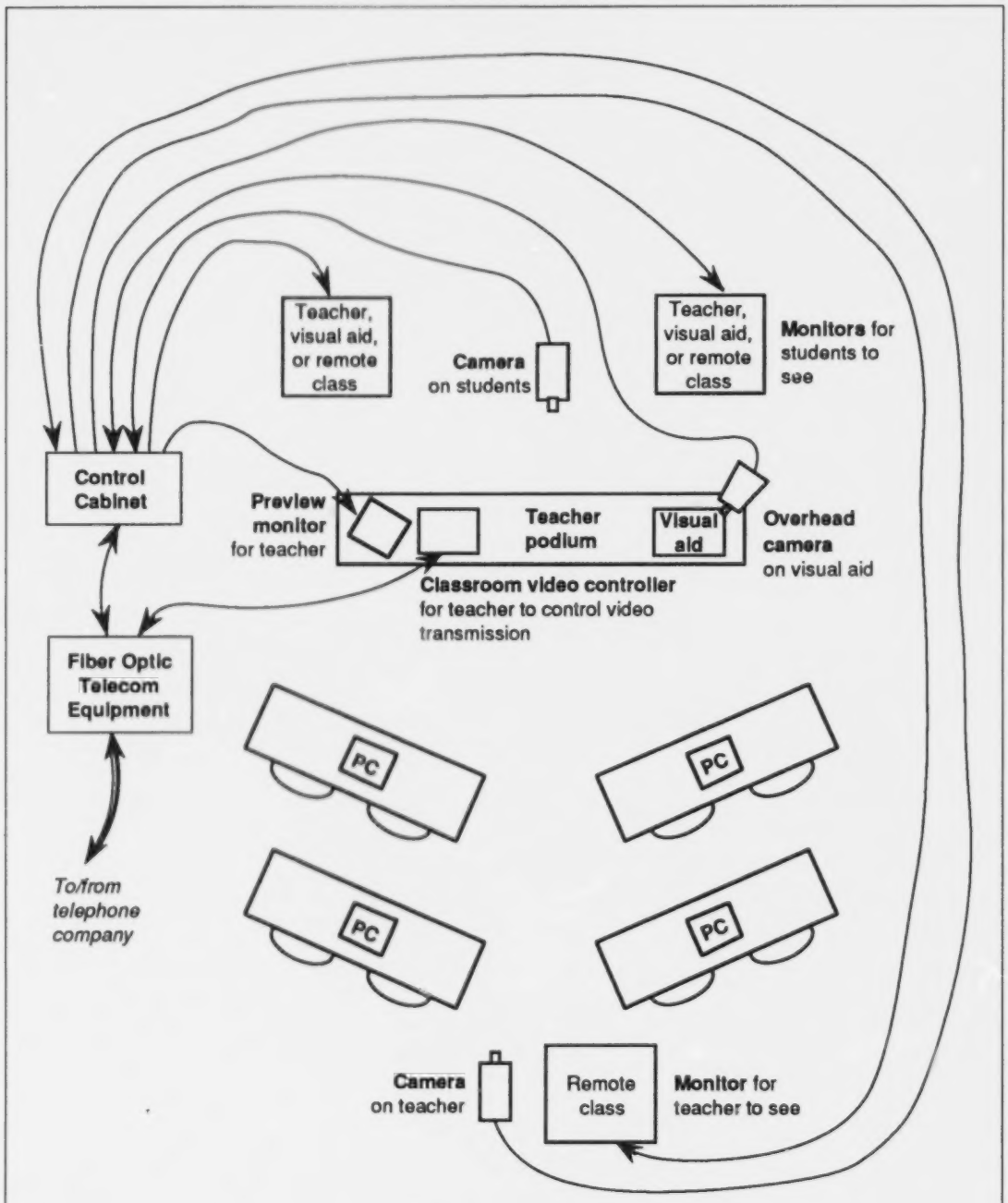
The classroom Each video classroom is set up identically. The basic setup is as follows:

- Three video cameras. One focuses on the students, for transmission to remote sites. If a class is originating from the classroom, the second camera focuses on the teacher, and the third, an overhead camera, focuses on visual aids on the teacher's podium.
- Four video monitors. Two monitors reside at the front of the room for the students to see. One resides in the back for the teacher to see. The fourth, a small preview monitor, sits on the teacher's podium for private viewing of the remote classrooms.
- A classroom video controller. The controller is a touch-screen computer with which the teacher controls what students see and hear during the class. Details of the controller operation are on page 30.
- Microphones and speakers, placed strategically throughout the room.
- Personal computers. A PC sits on each of the student desks. These PCs are part of a local area network (LAN) within the school and a larger wide area network (WAN) throughout the state.
- A control cabinet. Coaxial cables connect the control cabinet with the cameras, monitors, and any VCRs or laser disk players in the classroom. The teacher decides which input is to be transmitted over the network. Appropriate signals are transmitted out of the control cabinet over a single coax cable.

Other notes about the classroom and its configuration:

- A facilitator is present in each participating classroom, local or remote. Facilitators help aim and focus cameras and sometimes assist teachers with the classroom video controller. Facilitators are in constant contact with each other via a second voice channel in addition to the classroom voice channel.
- Both voice channels are carried over the same coaxial cable. And both channels provide high-quality, stereo audio.
- All video and voice signals are routed outside the school, through the broadband switch at MSU, and to all schools on the network. Even the video of the local teacher goes through this process.
- Voice signals are transmitted and received with the video signal. A teleconferencing system *is not* required.

Typical classroom equipment and setup for Mississippi 2000



Note: Microphones and speakers are not shown, but are located strategically throughout the room.

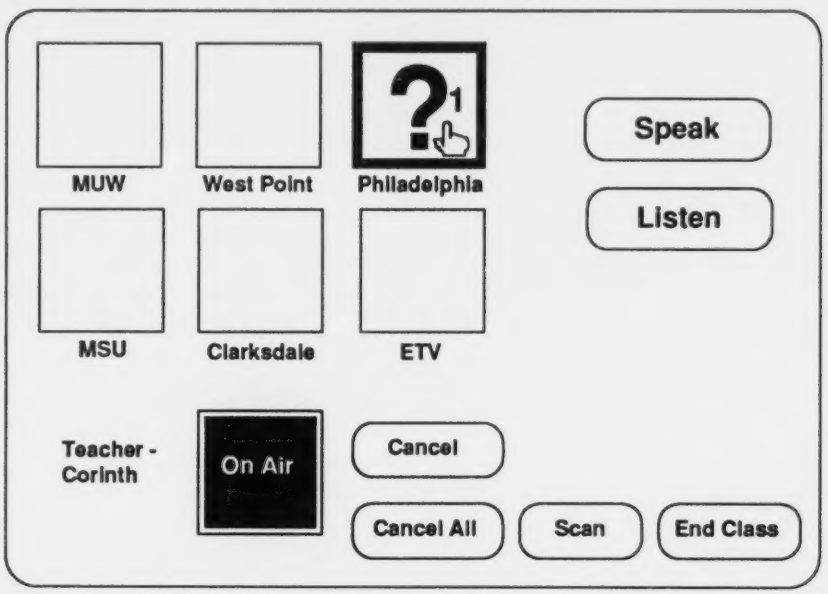
The classroom video controller The computer-based, classroom video controller and its interaction with the broadband switch provides teachers with the versatility that makes the Mississippi 2000 network so unique. The controller has two modes — lecture and interactive. Teachers use the touch-screen, mouse, or keyboard to select the mode and to control the video and voice interaction between the local and remote classrooms.

- When the controller is in lecture mode, the teacher chooses to transmit either his or her image or a visual aid. This is the image that is transmitted to the two monitors at the front of the remote classrooms.

  While in lecture mode, the teacher can view a small preview monitor to keep an eye on what's happening in the remote classrooms. The teacher can choose to display the remote classes on the monitor at the back of the classroom as well. The teacher can scroll through the classes at a pre-determined rate or select a specific classroom. In lecture mode, voice is not transmitted from the remote classrooms.

- When the controller is in interactive mode, the teacher receives indication on the screen if a remote student has a question. Using the touch screen, mouse, or keyboard, the teacher selects the school. The teacher and the remote site then see and hear each other. This gives the teacher an opportunity to preview the question. Normally, the teacher chooses to transmit the video and voice of the student so all classrooms can hear. Then, when ready to respond, the teacher selects his or her own video and voice for transmission to all classes.

  The illustration below shows a sample screen indicating that the teacher at Corinth is on the air and that a student at Philadelphia High School has a question and is being previewed by the teacher.

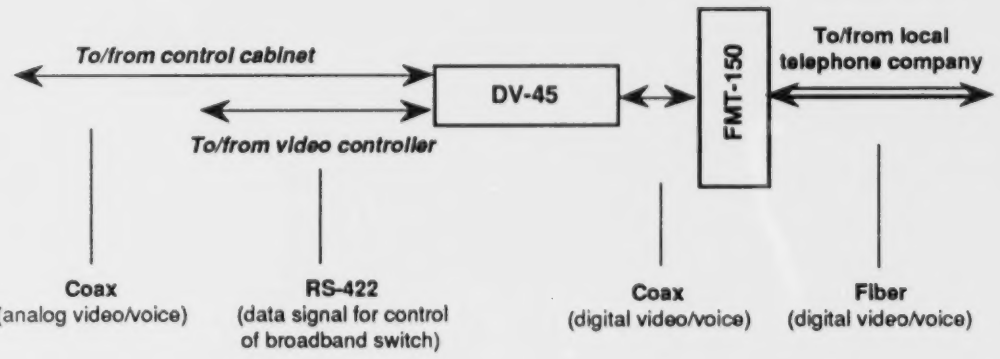


The school / telephone company connection Once the video and voice signals leave the control cabinet, optical fiber equipment converts them to digital, multiplexes them, and transmits them over fiber to the local telephone company. The telephone company routes the signals to Mississippi State University, where the broadband switch resides. (Remember, all transmissions are routed through the broadband switch.) Then the fiber equipment at MSU routes the signals back through the network to the appropriate schools.

School to telephone company:

- A DV-45 video codec (coder/decoder) resides in each classroom. The video input to the codec is the coaxial cable from the control cabinet. As the analog video, voice, and data signals arrive, the DV-45 video codec samples and digitizes the signals. Then, the codec passes the signals over coax cable at 45 megabits/second (DS-3) to a fiber multiplexor terminal.
- An FMT-150 fiber multiplexor terminal is located in the same cabinet as the DV-45. The FMT-150 transmits the digital video and voice signals over the fiber that connects the school with the local telephone company central office.

Typical Mississippi 2000 classroom optical fiber equipment



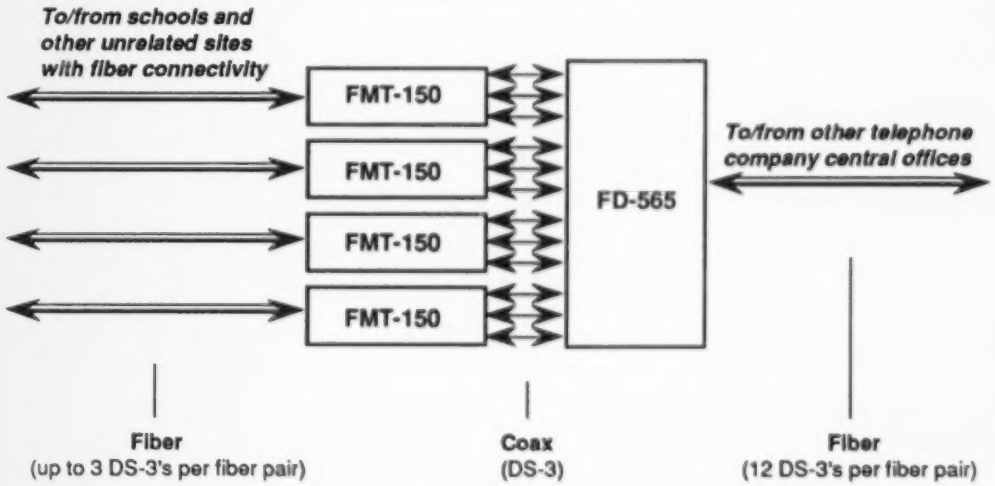
For transmission, DV-45 codec converts standard analog video and voice signals to digital. DV-45 also combines data signal from classroom video controller with video and voice signals. FMT-150 transmits the combined digital signals over fiber. For reception, process is reversed.

Because the network is switched, only one DS-3 connection is needed for each site.

Telephone company to telephone company:

- When the signals reach the telephone company, similar FMT-150 fiber multiplexors retransmit the signal to an FD-565 fiber multiplexor, which multiplexes (or combines) the digital signals with digital signals from other sources and sends them to their destination at speeds of 565 megabits/second (12 DS-3's). This multiplexing is what allows the Mississippi 2000 network to share the fiber circuits with other South Central Bell customers.
- When the digital signals reach the receiving telephone company, the process in the above step is reversed. The signals are split, re-multiplexed and retransmitted toward their destination.

Typical Mississippi 2000 telephone company



FMT-150's de-multiplex the DS-3 digital signals from the school and unrelated sites. FD-565 multiplexes the signals and transmits them over fiber to FD-565's at other telephone companies.

Each FD-565 can multiplex up to 12 DS-3's (from 4 FMT-150's).

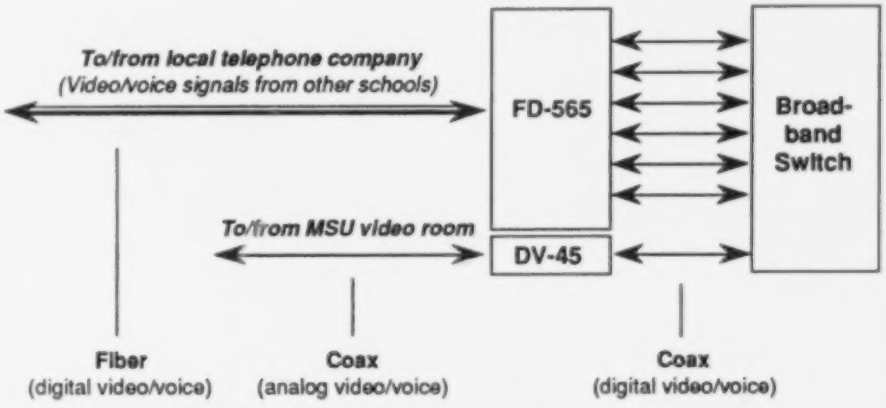
Telephone company / Mississippi State University (MSU) The various telephone company offices route all video and voice signals to Mississippi State University (MSU), where the broadband switch resides.

Telephone company to MSU:

- The DS-3's carrying the video and voice signals from the telephone company pass through an FD-565 fiber multiplexor at MSU. The FD-565 de-multiplexes the signals and passes them on to the broadband switch.

- The MCS 3800 broadband switch, under control of the teacher using the classroom video controller, makes the appropriate connections and retransmits the signals back through the FD-565 and over the network to the appropriate schools.

MSU equipment room



All classes are input to MSU for switching. Digital signals come from local telephone company into MSU's FD-565. Broadband switch makes appropriate connections and transmits signals back through FD-565 and on to remote schools or through DV-45 to MSU video room.

If a class originates at MSU, DV-45 converts analog video/voice signals to digital and transmits along with data to broadband switch. Broadband switch makes appropriate connections and forwards signals through on-site FD-565 and on to local telephone company.

MSU back to the schools:

- Once the digital video and voice signals leave MSU, they go from telephone company to telephone company (in the manner previously described) and to their destination schools.
- At the destination schools, the fiber multiplexors pass the signals to the codecs.
- The video codecs reverse the sampling process and convert the digital signals to analog video and voice. Then they transmit the analog signals over coax cable to the control cabinet and the appropriate monitors and speakers.

Sound time consuming? It isn't. All of this happens in milliseconds — less than the time it takes you to blink your eyes!

Expanding the switched network

Adding a new school to the network is easy. The new school must have cameras, monitors, and optical electronic equipment. Add cabling within the school and fiber to the the local telephone company, and update the broadband switch. That's it. *Nothing additional is required in any of the other classrooms.*

New video classrooms will be equipped like the original classrooms — one monitor for the teacher and two for the students, plus video and voice transmitting and receiving equipment.

What's next in Mississippi?

The most obvious next step in Mississippi is to add additional schools to the network. Community involvement also is an important objective. Plans include leadership training from the Mississippi Leadership Council, adult literacy volunteer training from MSU, county and health agency training, in-service teacher training, industry training, and computer-based training.

The Mississippi 2000 project team also will continue to study the use of the network. They will continue to experiment with video and computer applications as they relate to regular curricula. And they will work with teachers to ensure that students' needs are met. After all, the most important components in the network are the children and adults who use it.

It's not difficult to imagine the positive affect that Mississippi 2000 will have on the state. From increased opportunities for students and teachers to an improved telecommunications infrastructure within the state, all citizens will benefit. It's a model that other educators, state governments, and private industry should consider when reviewing distance learning plans for their states. Mississippi 2000 demonstrates how versatile and effective distance learning can be, especially when its transmission medium is the public switched network.

Results

Although Mississippi residents have just started to use the network, they have high expectations for its success. Their comments are well worth reading and thinking about.

- A. J. Jaeger, Educational Television: "... and these kids in rural Mississippi, often in desperate economic circumstances, are going to be pioneers. They are going to be astronauts in education."
- Johnny Franklin, Math & Science High School: "This is my 24th year in Mississippi education. To see things like this being offered, being made available, it's a chance for people in Mississippi to take a very innovative program, one of the first nationally, and to be able to make it into a success story. I can't tell you how that stimulates and excites."
- Pat Teske, Department of Education: "For the department, it's going to allow the school districts to expand their curriculum. It's going to allow us to have examples of exemplary programs in four high schools, four high schools that are in totally different regions in the state ..."
- Therrell Myers, Philadelphia Public Schools: "... It's going to ... provide our children the opportunity to be more competitive at the national and international levels due to the technology advancement."
- A. J. Jaeger, Educational Television: "Mississippi is particularly suited for distance learning. In fact, it's going to be essential if we're going to develop economically and improve the quality of life of our citizens."
- A. J. Jaeger, Educational Television: "We've put a lot of faith and store in the ability of technology to deliver us from various problems, but in the final analysis the people will make this project successful. The cooperation that we have from the private sector and the public sector, the parents and families and administrators and principals and mayors and educators across the state will make this program a success ... one that the rest of the country can look to as an example."

Jaeger's words are worth remembering. It's easy for some to fear technology as a displacement of teachers. But that just doesn't happen. No matter how great the technology is, without the facilitation of teachers, the enthusiasm of students, and the support of parents, educators, and technology providers, the technology is nothing but a heap of useless hardware and software. However, with talented educators and lots of cooperation and support from everyone else, technology can become a powerful tool that assists educators in offering new opportunities to students of all ages, regardless of economic status or location. And that's the goal of Mississippi 2000.

Appendix: Presentation Materials

This appendix contains abbreviated information from chapters 1, 2, and 3 in a presentation format. Please feel free to make overhead transparencies from the information.

northern telecom

Distance Learning Using Digital Fiber Optics

Applications, technologies, and benefits

northern telecom

Distance Learning Eases Isolation

Problems:

- **Rural**
  - **District areas are large, sparsely populated**
  - **Inadequate population / funding cannot support special teachers**
  - **Peer communications are poor**
  - **In-service training is difficult**
- **Urban**
  - **Concern with majority leaves little time for gifted students**
  - **Poorer tax base results in inadequate funding**
- **Wealthier districts**
  - **Inadequate enrollment cannot support some special classes**
  - **Qualified teachers are difficult to find**
- **Traditional homebound learners**
  - **Some are unable to attend classes**
  - **Some desire to learn at home**

Solution: Distance learning improves communications and facilitates resource sharing.

How Technology Has Affected Distance Learning

- Print technology
- Video
- Telephone
- Video and telephone
- Two-way video / voice
  - Full-motion video
  - Compensated-motion video

Summary of Distance Learning Technologies

- Voice teleconferencing
- Audio-graphics teleconferencing
- One-way satellite / cable networks (public)
- Microwave networks (private)
- Compensated-motion (compressed) video
- Full-motion video using digital fiber

Why Full-Motion, Digital Fiber Optics?

- Picture quality
- Unlimited distances
- Transmission capabilities
- Versatility

Oklahoma Panhandle – The Problem

Regional situations:

- **Districts with limited enrollment spread over large area**
- **Economic decline**

Led to education problems:

- **Inability to support qualified teachers**
- **Possibility of school closures**
- **Lack of educational opportunities for students**

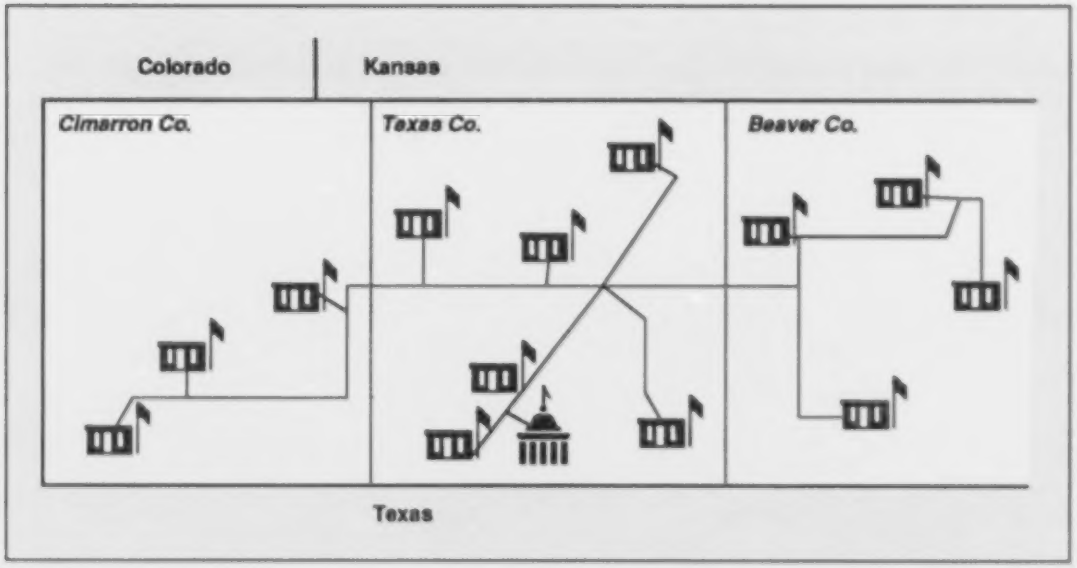
Oklahoma Panhandle – The Solution

A full-motion, digital, fiber-based network

- **Full-motion to replicate the live classroom**
- **Fiber for speed**
- **Digital for**
  - **Picture quality**
  - **Network versatility**

northern telecom

Oklahoma Panhandle – The Network

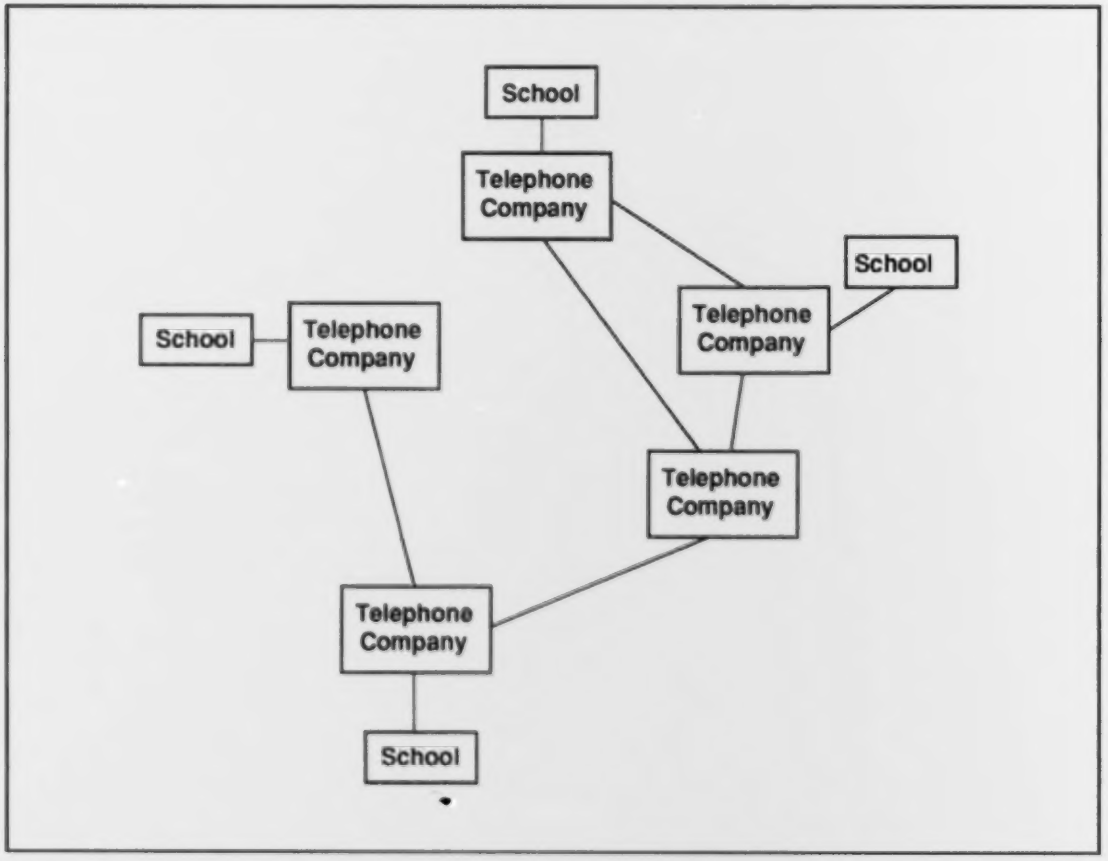


northern telecom

The Panhandle Shar-Ed Video Network

- 1989-90 school year
  - Four Beaver County schools, four classes
- 1990-91 school year
  - Original four Beaver County schools, 7 classes
  - Three Texas County schools, 3 classes plus speech therapy
  - University graduate class spanning Beaver and Texas counties
  - Enrichment programs for 5th and 7th graders
  - Community classes

School / Telephone Company Overview



60

61

The Classroom Setup

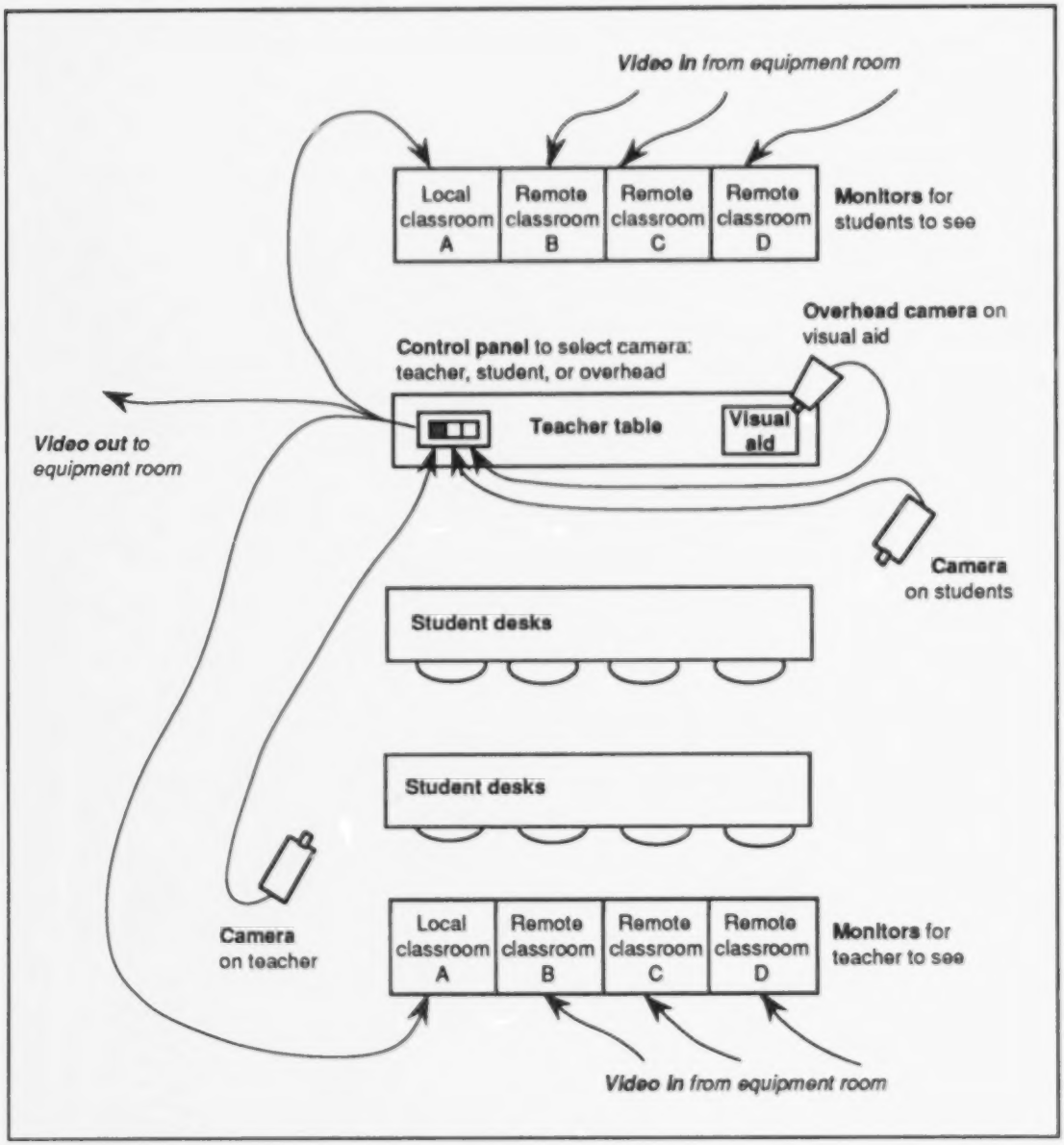
Configuration:

- Three video cameras
- One video control panel
- Eight video monitors
- Microphones and speakers

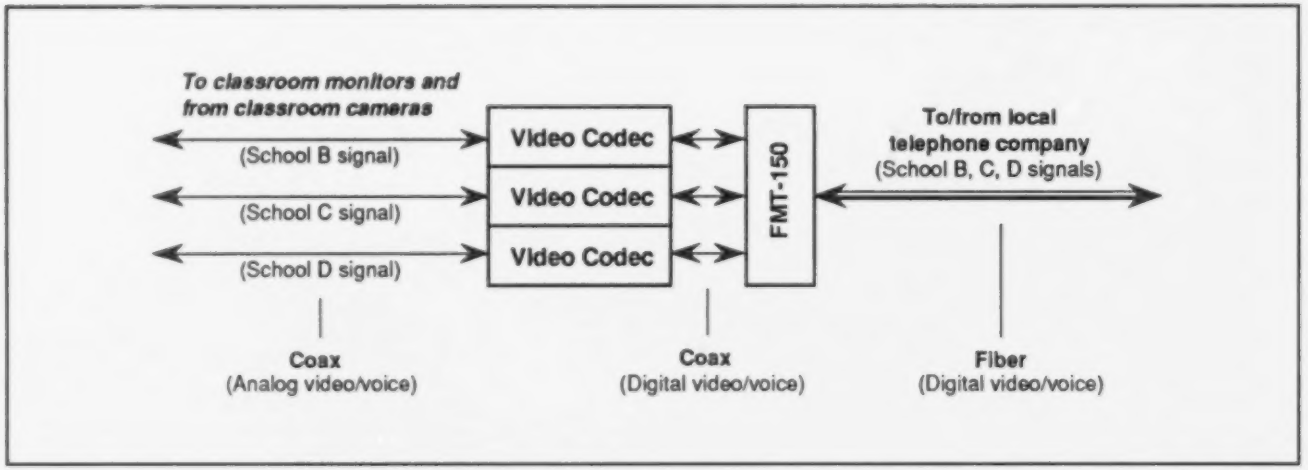
Other notes:

- School video cabling is coax
- Teleconference system *not* required

Typical Panhandle Network Classroom

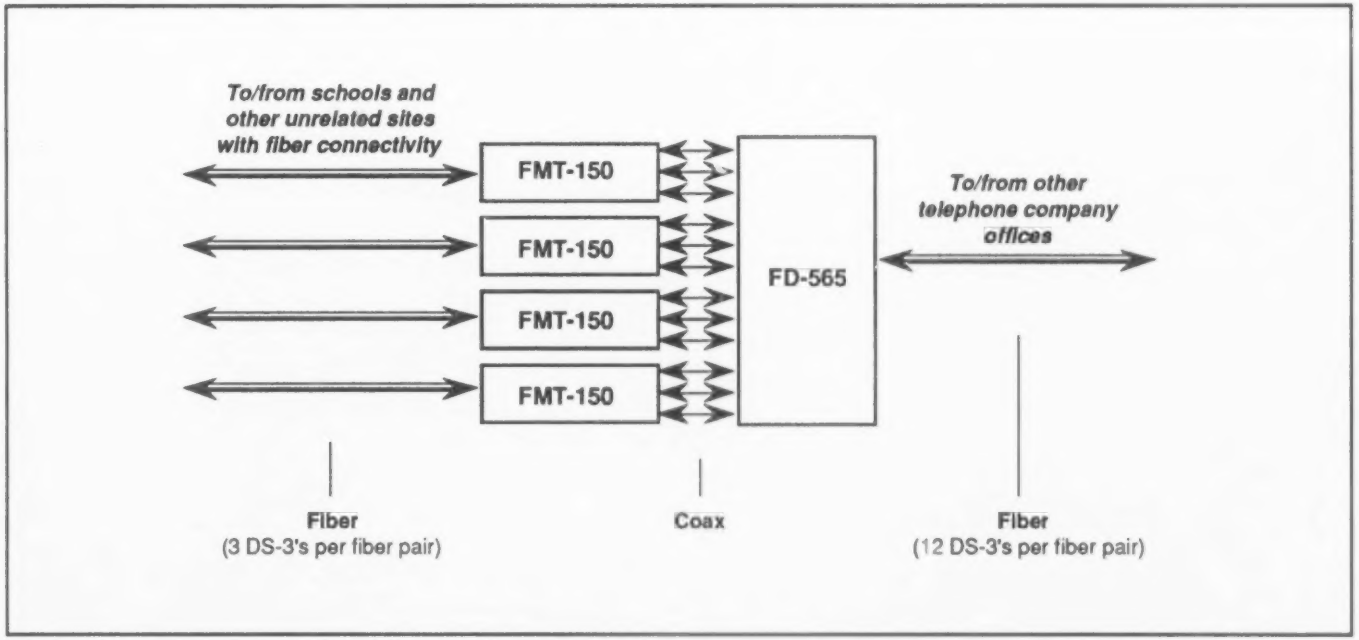


School / Telephone Company Connectivity



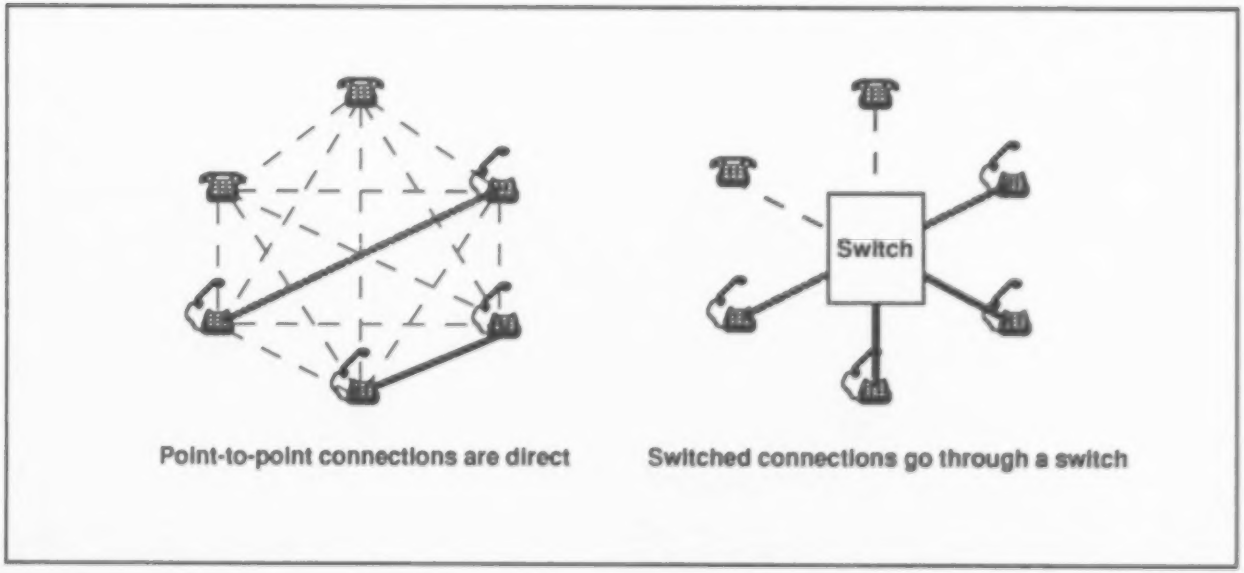
- Video codec
  - Samples and digitizes signals
  - Transmits signals to FMT-150
- FMT-150 Fiber Multiplexor Terminal
  - Combines digital signals
  - Transmits to telephone company

Telephone Company / Telephone Company Connectivity



- FMT-150 transmits signals to FD-565 fiber multiplexor
- FD-565 transmits signals to other telephone companies

Point-To-Point vs. Switched Telephone Networks



Point-To-Point vs. Switched Fiber Networks

- Point-to-point
  - Adding schools means adding equipment to all schools
  - Classes cannot be held simultaneously

- Switched
  - Adding schools means adding equipment to new schools only
  - Classes can be held simultaneously

Expanding to a Switched Network in the Panhandle

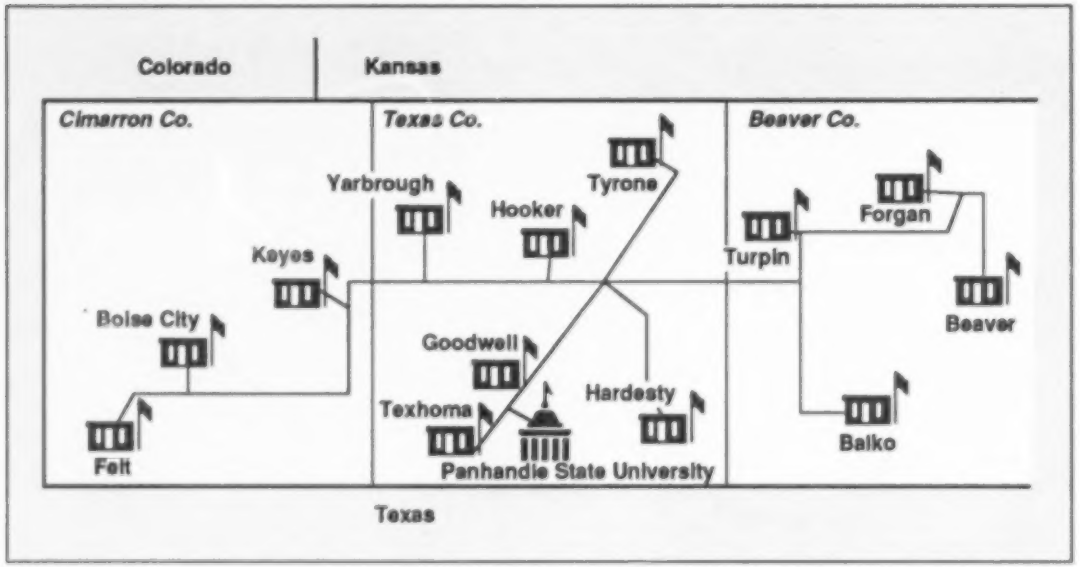
- New classrooms equipped as the original four
- No additional equipment required for classrooms already on the system
- Transmission capabilities
  - Four classrooms can have two-way communications
  - Unlimited number of classrooms can hear transmitted class
  - Classes can be held simultaneously
- Classes can be
  - Scheduled
  - Held on ad hoc basis

What's Next in the Oklahoma Panhandle

- Winter / spring 1991
  - 3rd grade math for Chapter I students
- July 1991
  - Panhandle State University (PSU)
- 1991-92 school year
  - Three additional Texas County schools
  - Three Cimarron County schools
- Expanded community programs and vocational training

northern telecom

The Panhandle Shar-Ed Video Network, 1991-92



77

78

Original Goals

- √ State-of-the-art video network
- √ Transmission to any or all schools
- √ Transmission from any school on the network
- √ Simultaneous classes
- √ Two-way video / audio
- √ Expansion throughout the Panhandle

Mississippi 2000 – The Problem

The regional situation:

- Small, isolated schools in rural environment
- Lack of adequate funding
- Difficulty in peer communications among teachers

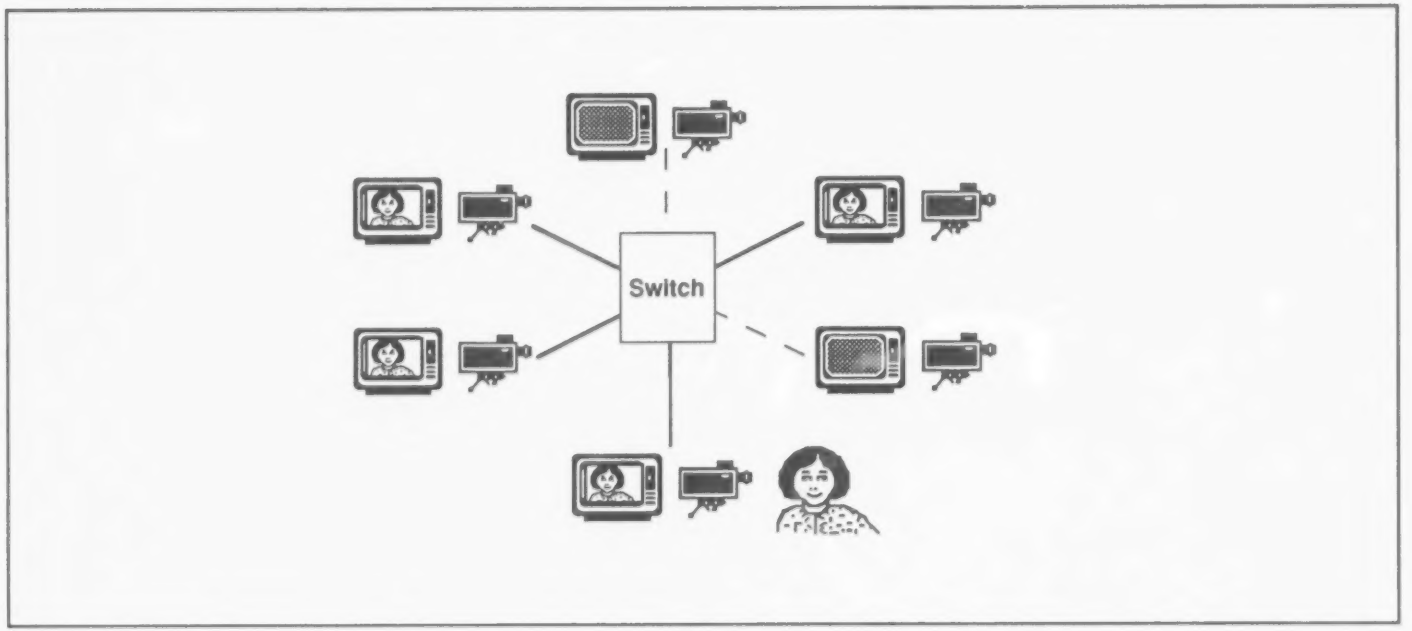
Led to education problems:

- Difficulty in recruiting specialized teachers
- Failure to offer advanced placement classes
- Lack of educational opportunities for students

Mississippi 2000 – The Solution

- Multi-media distance learning network
- Based on digital and fiber technologies existing in Mississippi
- Public and private effort

The Network is Switched



The switch makes the connection between all course participants

Why Switched Video?

- Cost-effectiveness
  - Only new schools need new equipment
  - Simultaneous classes increase network use
- Versatility
  - Multiple, simultaneous classes
  - Pre-programmed scheduling as well as ad hoc

Other Mississippi 2000 Requirements

- Off-the-shelf software and hardware
- Adherence to existing telecommunications standards
- Open architecture
- Ease of use

Mississippi 2000 Project Team

- South Central Bell
- Northern Telecom
- IBM
- ADC Telecommunications
- Apple Computer
- Mississippi DOE
- Mississippi Authority for Educational TV

Mississippi 2000 – The First Phase

Who's on the network:

- **Four high schools (Corinth, Clarksdale, West Point, Philadelphia)**
- **Mississippi State University**
- **Mississippi University for Women, Mississippi School for Math and Science**
- **Educational TV**

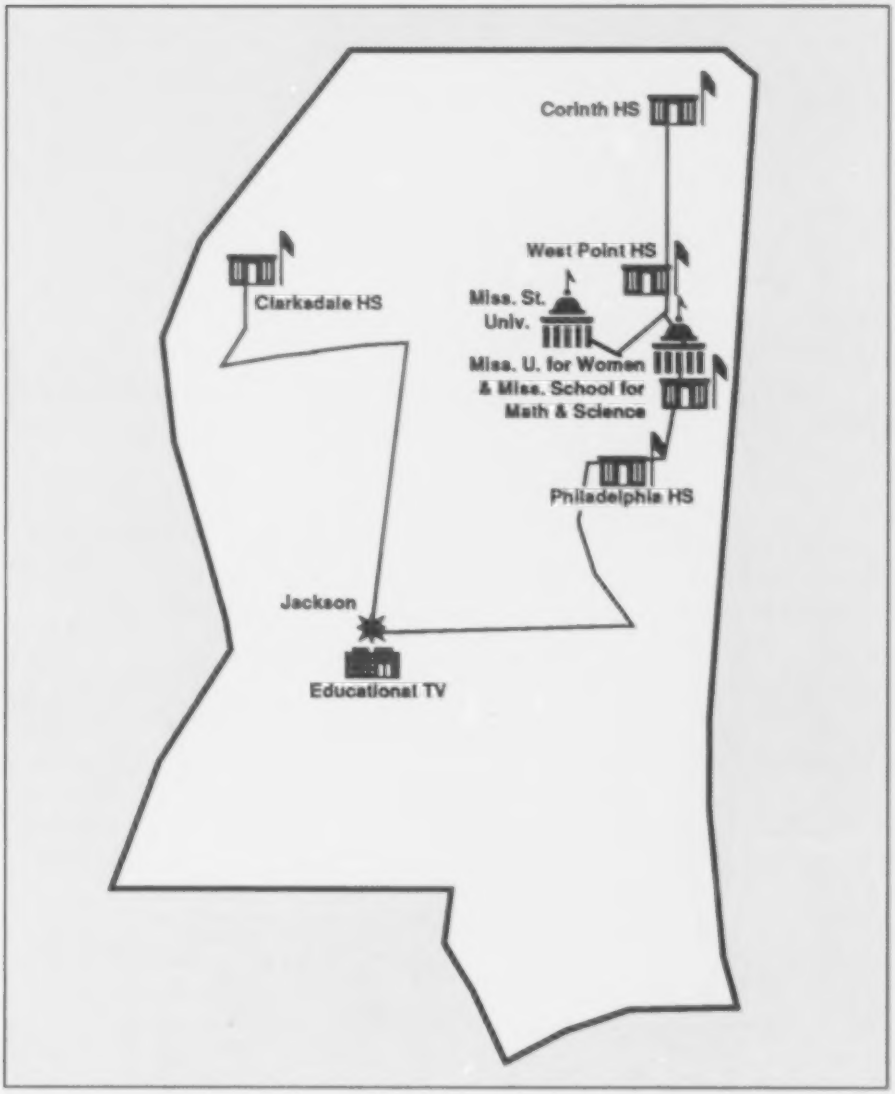
Activity 1/91 through 6 /91:

- **5 classes**
- **Team curriculum development and teaching**
- **Fine-tuning of curricula**
- **Refinement of teaching methods**

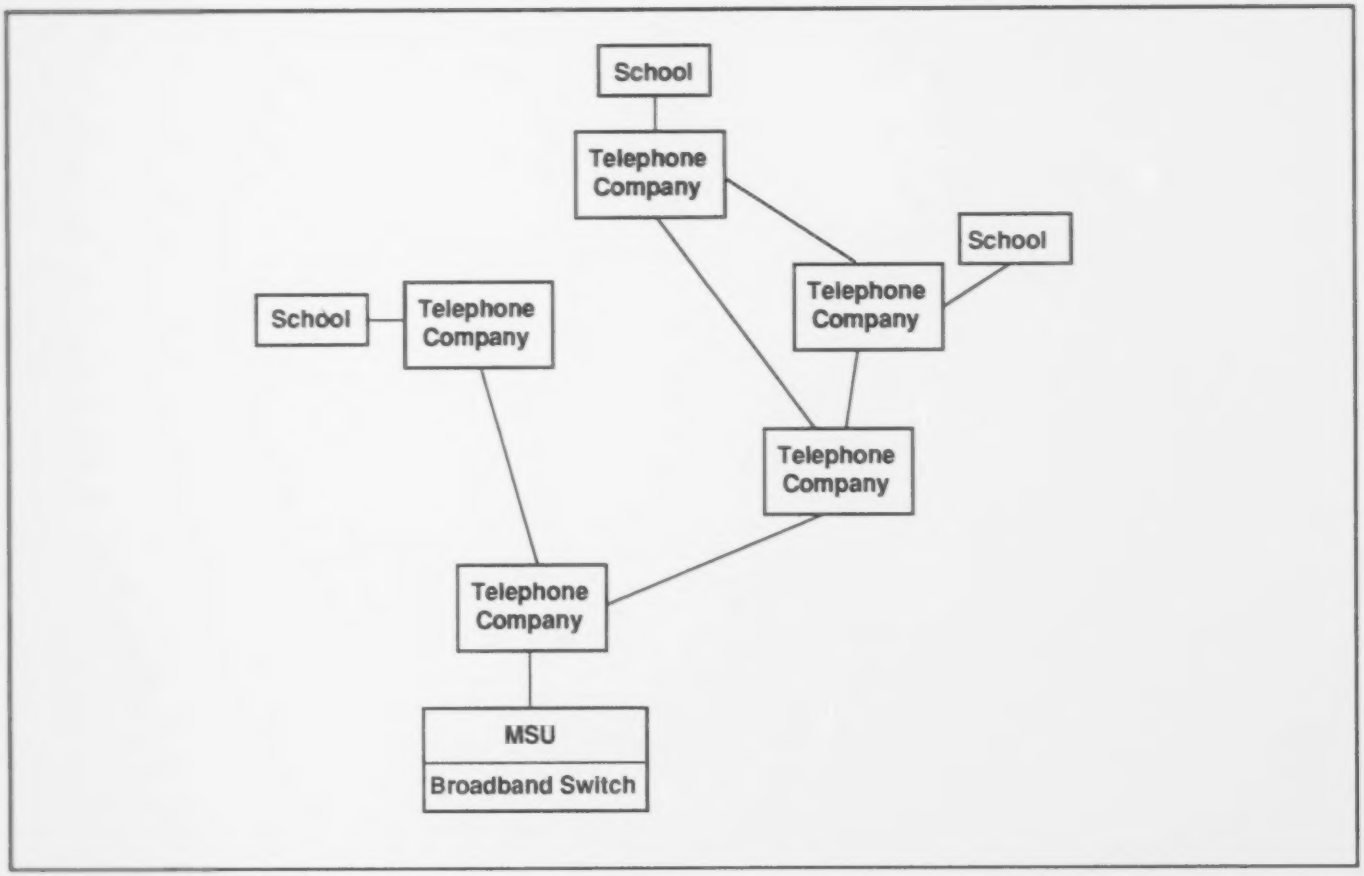
93

94

The Mississippi 2000 Network



School / Telephone Company Overview



96

97

The Classroom Setup

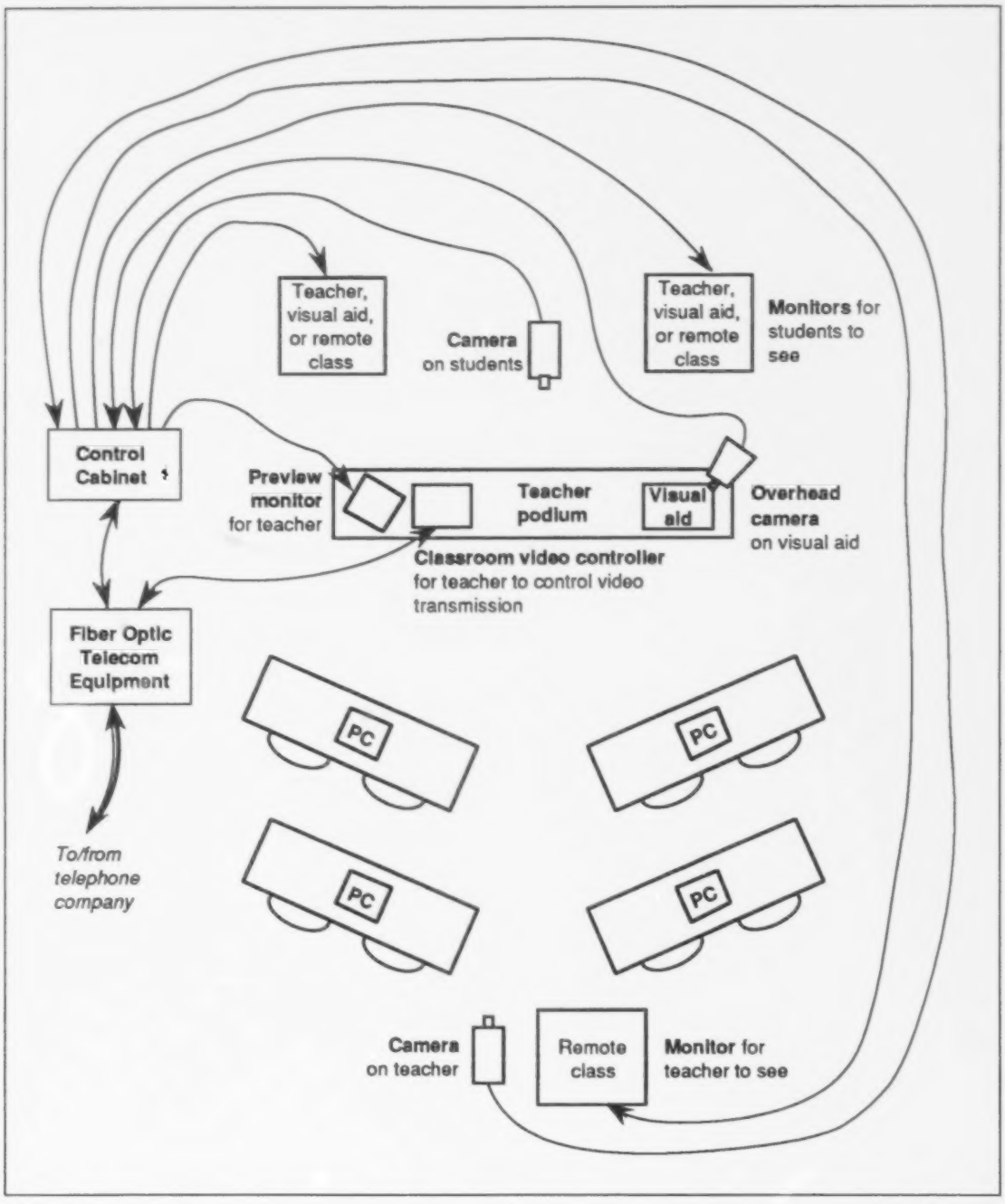
Configuration:

- Three video cameras
- Four video monitors
- Classroom video controller
- Microphones and speakers
- PCs
- Control cabinet

Other notes:

- Classrooms require a facilitator
- Two voice channels are used
- All video and voice is routed through the broadband switch at MSU
- Teleconferencing system is *not* required

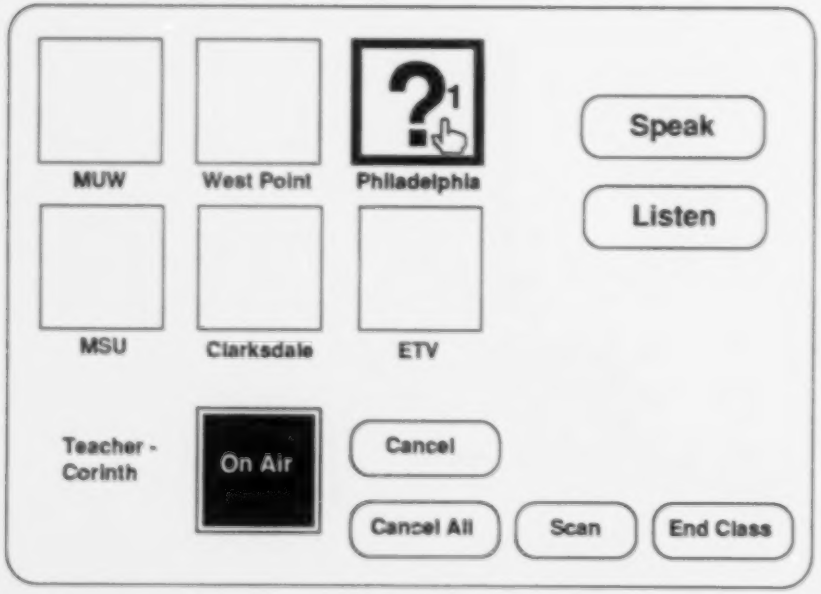
Typical Mississippi 2000 Classroom



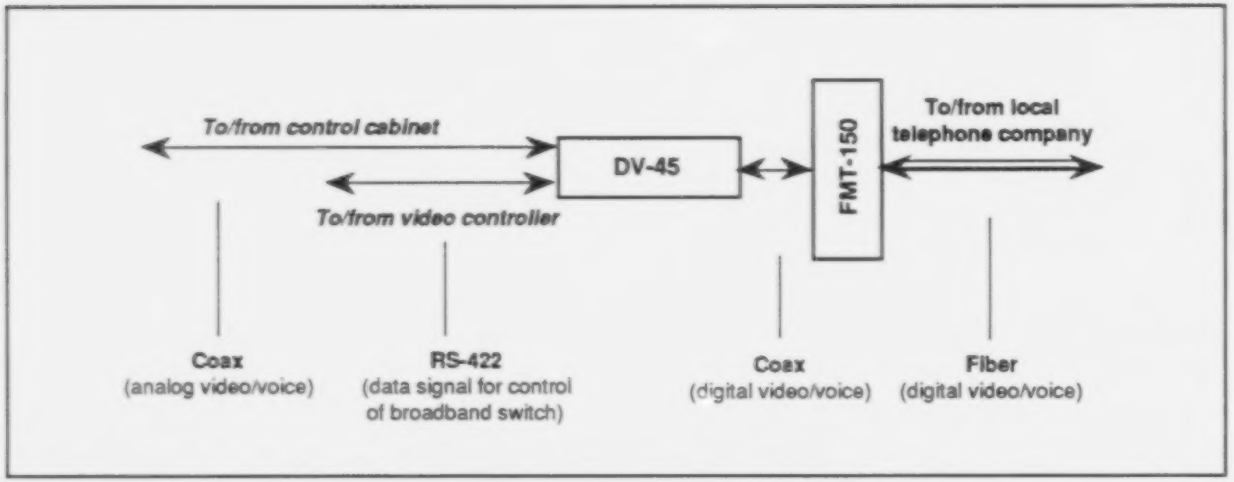
Classroom Video Controller

- Touch-screen computer
- Used to control broadband switch at MSU from any classroom
- Two modes, lecture and interactive
  - Lecture
    - Teacher chooses self or visual aid for transmission
    - Teacher views remote classrooms at pre-determined rate or by selection
    - Voice from remote classrooms is not heard
  - Interactive
    - Teacher responds to signal that remote student has question
    - Teacher chooses self or remote student for transmission

Sample Classroom Video Controller Screen

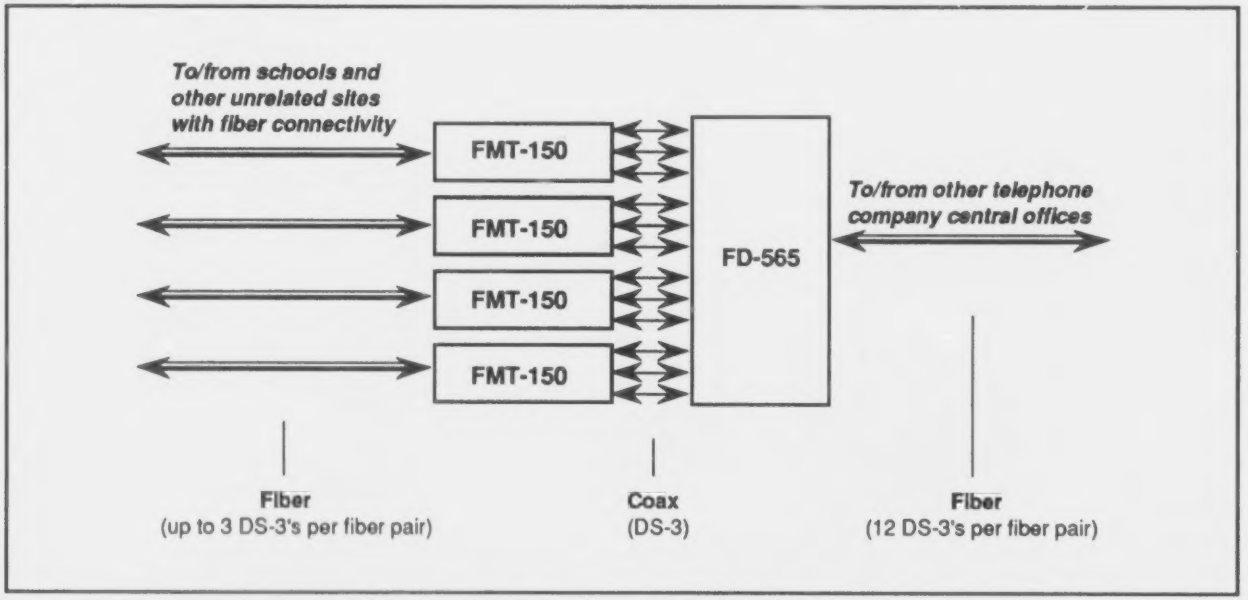


School / Telephone Company Connectivity



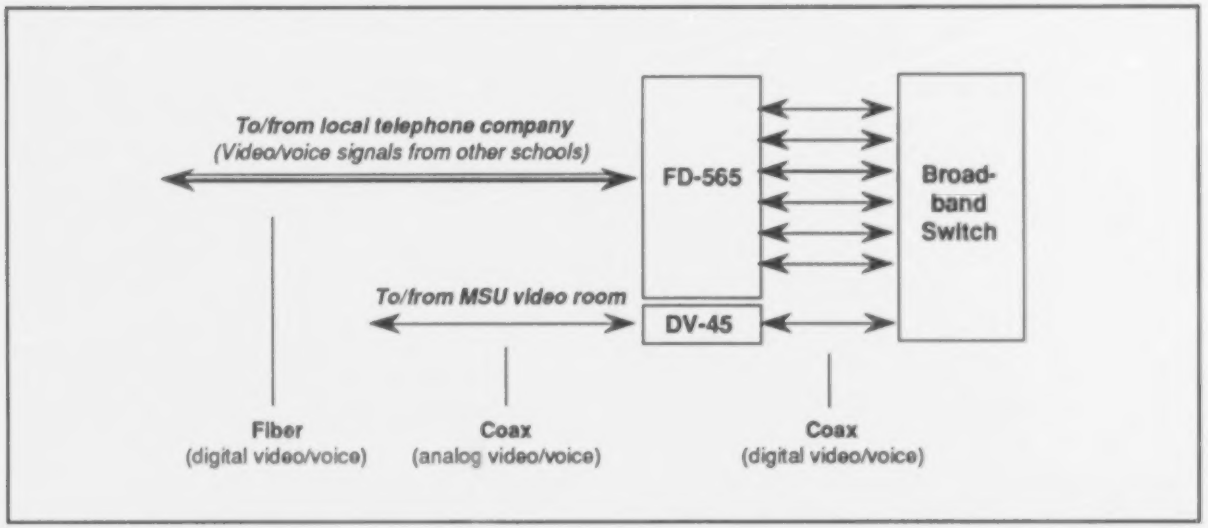
- Video codec
  - Samples and digitizes analog signals
  - Combines video / voice signals with video controller signal
  - Transmits signals to FMT-150
- FMT-150 Fiber Multiplexor Terminal
  - Combines digital signals
  - Transmits to telephone company

Telephone Company / Telephone Company Connectivity



- **FMT-150 transmits signals to FD-565 fiber multiplexor**
- **FD-565 transmits signals to other telephone company offices**

Telephone Company / MSU Connectivity



- FD-565
  - Receives signals from telephone company
  - De-multiplexes signals
  - Transmits signals to broadband switch
- Broadband switch, controlled by teacher, makes connections and transmits signals back to FD-565
- FD-565 transmits signals to telephone company or to local video room

northern telecom

Expanding the Mississippi 2000 Network

- New classrooms equipped like the originals
- No additional equipment required for classrooms already on the system
- Broadband switch updated for new class

111

112

What's Next for Mississippi 2000

- Addition of new schools
- Increased community participation
  - Leadership training
  - Adult literacy volunteer training
  - County and health agency training
  - In-service teacher training
  - Industry training
  - Increased computer-based training
- Continued study of network use and effectiveness

Digital fiber optics can help educators today and well into the future!

Distance Learning
Using Digital Fiber Optics

Applications, technologies, and benefits

Address comments to:
Education Systems
Northern Telecom Inc.
2435 N. Central Expressway
Richardson, TX 75080
214-301-2833

© 1991 Northern Telecom
All rights reserved.
IBM is a registered trademark of International Business Machines Corporation. Macintosh is a registered trademark of Apple Computer, Inc.
ES 9101
February 1991
Printed in USA.

BEST COPY AVAILABLE